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ABSTRACT

Forestry planning is essential if the global trend toward deforestation is to be reversed. World forest trends, although often based on inaccurate or misleading information put out by national governments, indicate that the area of land covered with closed forests has decreased from about 25% in 1950 to about 20% in the 1970s. Major causes of deforestation include logging, spread of agriculture, and collection of firewood. Among the economic consequences of uncontrolled deforestation are forest-product scarcity, rising dependence on imported forest products, increasing construction costs, inflation, soaring firewood and fuel prices, health deterioration due to lack of heat and warm food, shortage of paper, and increased flooding in watershed areas. Challenges facing world forestry include putting a halt to deforestation and meeting elementary fuel and wood needs of developing nations. Countries which have succeeded in reforesting their depleted areas include China and South Korea. In addition, other developing nations are beginning to recognize the urgent need for reform of forestry policies and are developing strategies to improve timber management practices. An example of a state which is experimenting with community forestry is Gujarat, India. (DB)

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Planting for the Future: Forestry for Human Needs

Erik Eckholm

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When surrounded by the synthetic materials of the modern age, people can easily forget their dependence on trees. In the rural areas of the Third World, the importance of forests, which provide essential cooking fuel and building materials, is obvious enough. But economic advancement does not reduce a society's reliance on forest products. As countries develop, wood remains a basic raw material for construction and also takes such useful forms as furniture, railroad ties, power poles, cellophane, rayon, and plastics. Transformed into paper, it serves as an essential tool for government, commerce, education, and communications. In the years to come, wood may also provide liquid fuels and a wide array of petrochemical substitutes. For urbanites, forests provide natural havens of inestimable value to mental health, while trees both in and out of cities help create a more pleasant and comfortable milieu.

Forests perform irreplaceable ecological services as well as provide economic products and recreation. They assist in the global cycling of water, oxygen, carbon, and nitrogen. They lend stability to hydrological systems, reducing the severity of floods and permitting the recharging of springs, streams, and underground waters. Trees keep soil from washing off mountainsides and sand from blowing off deserts; they keep sediment out of rivers and reservoirs and, properly placed, help hold topsoil on agricultural fields. Forests house millions of plant and animal species that will disappear if the woodlands are destroyed.

Recent writings about the "basic needs" of the world's poor have generally ignored the fundamental importance of forests to human well-being, an analytical blind spot reflected in the paucity of programs to reduce the forest deprivation now suffered by many. Describing conditions in the central Indian state of Madhya Pradesh, but with words applicable to much of the Third World, forester R.

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Chakravarti writes: "It is often said that the three basic human needs are food, clothing and shelter. One cannot think of food and shelter without wood, which is a more basic need. In fact it may be truthfully said of an average villager of the State that he is still in the 'wood age.'"[1]

Cultivation in Madhya Pradesh, as in many underdeveloped areas, relies mainly on wooden plows, and produce is transported in wooden bullock carts. Houses are built of wood and mud or bamboo and thatch. Wood is required for a host of other purposes such as fencing, furniture, implements, and handicrafts. Above all, continues Chakravarti, "wood, a marvelous, God-given means of storing solar energy, is also required to cook food with. . . . In fact the production of food-grains without the means to cook them and make them edible would appear to be a half-hearted attempt at achieving freedom from hunger."

Nonwood forest products are important as well. In many regions, tree leaves and forest grasses sustain cattle, which in turn pull plows and carts and supply milk and fertilizer. Leaves, fruits, nuts, honey, and wild animals provide a significant share of the food supply of hundreds of millions of people. Traditional medicines and useful barks are taken from forests. Commercially valuable products such as mushrooms, drugs, gums, and resins are extracted from forests as well. Forests are often evaluated by economists in terms of their ability to provide a dead product—wood; but for many of those residing in and around them, forests are a living, dynamic resource.[2]

The global pattern of forest-product use and distribution mirrors the pattern of economic wealth and development. Eighty percent of the wood used in the Third World is burned for fuel, and much of it never passes through a commercial market. Though developing countries contain three-fourths of the world's people and more than half its forests, they account for just 13 percent of global consumption of "industrial wood"—marketed logs, sawn wood, panel products such as plywood and fiber board, paper, and other manufactured products. Annual per capita paper use in developing countries is six kilograms, compared to 257 kilograms in North America. In fact, each

"Each year the average American consumes about as much wood in the form of paper as the average resident in many Third World countries burns as cooking fuel."

year the average American consumes about as much wood—one cubic meter—in the form of paper as the average resident in many Third World countries burns as cooking fuel.[3]

About one-third of the world's industrial wood is traded internationally. Four-fifths of the trade originates and ends in developed countries, with North America and the Soviet Union having a surplus and Japan and Western Europe a deficit.[4] Partly because of the plethora of specialized forest products used in modern economies, most countries both import and export them to some degree. Hence the United States sends lumber to Japan and pulp and paper to many destinations, but imports enough wood and paper, mainly from Canada, to be not only a net importer but in fact the world's largest single importer of forest products.

Many poorer tropical countries export timber, usually as unsawn hardwood logs, but these countries, like most other developing nations, must import much of their paper and manufactured wood products. Southeast Asia exports a large volume of timber to Japan in particular, while African tropical logs go mainly to Western Europe.[5] With wood, as with other resources, buying power rather than need determines the global allocation of traded products.

According to demand projections by the Food and Agriculture Organization (FAO) based on expected rises in income and population, worldwide consumption of wood for all purposes will grow from 2.5 billion cubic meters in 1976 to 4 billion cubic meters in 1994. Commercial wood demand is rising particularly fast in less developed countries, most of which combine rapid population growth and relatively high economic growth rates with low current levels of industrial wood consumption. The FAO projects that Third World consumption of wood-panel products and paper will quadruple over the next two decades, and that consumption of sawn wood will rise by 50 percent a decade.[6] These latter estimates cover commercial demand only; even if they are realized, many poor people will remain deprived of basic forest products.

Even as the demand for industrial wood soars, a large proportion of humanity will continue to rely on firewood for cooking and home

heating. John Spears of the World Bank has assessed future firewood needs, based on optimistic assumptions about the spread of wood-conserving stoves and cooking alternatives such as biogas plants and solar cookers. According to his calculations, 20 to 25 million hectares of new plantations will have to be in place by the year 2000. At the current rate of planting for this purpose, only about two million hectares, one-tenth of what is needed, will be established. A recent analysis of energy prospects in the Sahelian zone of West Africa concluded that the planting rate must be multiplied 50-fold if regional firewood needs by the century's end are to be met.[7]

Leaving questions of accessibility aside, there are currently about 75 cubic meters of wood in the world's dense forests for every person. By the end of the century, however, the per capita amount of potentially exploitable timber will be nearly cut in half if the current deforestation rate is maintained, if existing population projections materialize, and if the worldwide tree-planting effort is not pushed far above its current level. This "transition from a period of global forest wealth to a period of global forest poverty," as it is described in a forthcoming U.S. Government study, would clearly have palpable and painful economic effects, particularly among the poorer groups within poorer countries. "Relative prices of industrial wood products, paper, sawn lumber, wood panels, wood-based chemicals, plastics, and many other products are sure to increase," the study concludes.[8] If they occur, these price rises will choke off demand well before the projected consumption increases come about, fueling inflation everywhere and denying people in forest-poor countries many of the benefits, and even some of the necessities, that forest products provide. Meanwhile, the continued loss of forests will accentuate the environmental costs of denudation already apparent in many countries—erosion, desertification, siltation, flooding, and the extinction of species.

To some extent, as economists are quick to point out, market forces automatically help offset timber scarcity. Higher prices will induce technological innovation and new investments, spur the substitution of alternative materials, and encourage the conservation and recycling of forest products. But in the forest sector, as in others, these natural

market tendencies alone will not provide an acceptable solution. In a world of extreme income disparities, the adjustments of the market take a heavy toll among those at the bottom, many of whom will have no good substitute for writing paper in school or for firewood on the hearth. Even in more affluent countries, rising forest-product prices will impose social burdens. Public policies that incorporate both the needed time horizon and the needed social vision into forestry planning are essential.

World Forest Trends

Important as forests are to human well-being, knowledge about their extent or the rate at which they are disappearing is surprisingly incomplete. Only about half the world's forests have been subjected to detailed surveys, and only a fraction of these have been surveyed more than once so that changes over time could be documented. The spreading use of satellite technologies is improving the situation: with the aid of remote sensing, Brazil's huge Amazonian forest has been mapped for the first time. Still, any discussion at present of global forest resources and trends must be based on a concoction of subjective observations and surveys of varied quality.

Definitional differences among surveys and misinformation, put out deliberately or otherwise, further bedevil forest statisticians. The last official U.N. World Forest Inventory, published in 1963, called 29 percent of the earth's land surface "forest land," but this figure included everything from thick rain forests to lightly wooded arctic tundra that would not fit many people's idea of forest at all. Government statistics on forest areas—which usually find their way into international statistics—are sometimes doctored outright and, in any case, frequently include large areas euphemistically labeled "unstocked." Clear-cut lands where natural regeneration is slow or impossible and even lands occupied by farmers are designated as forest in many Third World statistical books. For the economist, even a precise measure of densely wooded areas would be inadequate;

accessibility, steepness, and mix of species affect the commercial potential of a given region.

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At present, the best available global survey is that compiled by Swedish analyst Reidar Persson. In his data, he has usefully distinguished between "closed forests," where tree crowns cover 20 percent or more of the ground when viewed from above, and "open woodlands," where a scattering of trees provide a crown-cover of 5 to 19 percent. In general, only the closed forests would be suitable for commercial timber operations. While the gaps in data remain huge, Persson has adjusted government statistics in keeping with available field observations and surveys wherever possible.[9]

According to Persson's calculations, closed forests covered about one-fifth of the earth's land in the mid-seventies. (See Table 1.) The true proportion is quite likely to be even lower than that, for only outdated surveys exist for many regions, and areas recently cleared or severely degraded are almost certainly included in the totals. Open woodlands cover perhaps another 12 percent of the earth's land area; this estimate is even rougher than that for denser forests. Although firm comparisons with earlier global inventories are impossible, by one estimate the area of land covered with closed forests in 1950 amounted to about one-fourth of the earth's land surface, which gives some idea of the pace of change.[10]

In terms of sheer tree-covered area, Latin America and the Soviet Union lead by far among regions, with 680 million hectares of closed forest in each. From an economic perspective, however, such totals can be misleading. While most of the Soviet Union's trees are conifers, whose soft woods are sought after for construction and papermaking, a good share of them stand in remote, cold areas where harvesting is commercially unfeasible and growth is extremely slow. While the Soviet Union does enjoy a wood surplus, the widespread notion that it will become a major supplier of forest products to a wood-short world is not grounded in economic reality.[11]

The total for Latin America is so high largely because of the Amazon Basin, which is covered by the world's largest tropical moist forest.

Table 1: The World's Forests By Region, Mid-1970s

Region	Closed Forest	Closed Forest as Share of Land Area	Open Woodlands	Open Woodlands as Share of Land Area
	(million hectares)	(percent)	(million hectares)	(percent)
Latin America	680	33	280	14
USSR	680	30	240	11
North America	470	25	176	9
Asia	410	15	100	4
Africa	190	6	640	21
Europe	138	28	37	8
Oceania	89	10	105	12
World Total	2,657	20	1,578	12

Source: North American data from *Global 2000 Report;* all other from Reidar Persson, "Need for a Continuous Assessment."

But forest-product industries have not yet begun to make good use of many of the incredibly numerous species in rain forests. Much tropical timber exploitation to date has been, in the words of former FAO forestry chief K. F. S. King, "primitive, costly and wasteful," and of little lasting benefit to nearby residents. Although the Brazilian Government has recently unveiled controversial plans to expand Amazonian timber cutting and exports, the country has subsidized huge private tree plantations in its temperate south in order to meet its soaring domestic needs. Brazil is currently a net importer of forest products.[12]

As of the mid-seventies, there were about 0.7 hectares of closed forest for each of the world's four billion people. (See Table 2.) The disparities among regions, and among countries within regions, in per capita forest area are huge. Two or more hectares of forest stood per person in the USSR, Latin America, North America, and Oceania;

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only half a hectare or less per person existed in Africa, Europe, and Asia. Again, though, aggregates can mislead. Many people in Latin America, especially in Central America and the Andean countries, live amidst barren hills and wood scarcity; the richness of rain forests elsewhere in the continent means little to them. Residents of a few countries in Central and West Africa are surrounded by dense tropical forests, though people throughout much of Africa suffer from an extreme paucity of trees. Asia's forest area per person, an abysmal 0.2 hectares, is only that high because the remaining thick stands of Southeast Asia are included in the calculation. These forests aside, most of Asia faces an extraordinary scarcity of trees. Looking at the other side of the coin, Europe's forests, many of which have been intensively managed for more than a century, produce far more harvestable timber—and on a sustainable basis—than the low per capita figure might imply.

Table 2: Forest Resources Per Person, Mid-1970s

Region	Closed-Forest Area Per Person	Standing Wood Volume Per Person*
	(hectares)	(cubic meters)
Oceania	4.2	238
USSR	2.7	329
Latin America	2.1	253
North America	2.0	179
Africa	0.5	107
Europe	0.3	31
Asia	0.2	15
World Total	0.7	75

*Closed forests only. World total volume in open woodlands estimated to be about 12.5 cubic meters per person.

Source: North American data from *Global 2000 Report;* all other from Reidar Persson, "Need for a Continuous Assessment."

"Many developing countries, especially those in the humid tropical belt, are now experiencing rapid and massive forest destruction."

Estimates of the rate at which closed forests are disappearing range from 10 to 20 million hectares each year, with the most recent surveys suggesting that a total near the lower end of that range is probably correct. Nearly all the shrinkage in closed-forest area is occurring in the humid tropics; in the best published analysis of tropical moist-forest trends, Adrian Sommer estimates that their total area is declining annually by about 1.2 percent, or 11 million hectares—an area the size of Bulgaria or Cuba. Covering 935 million hectares in the mid-seventies, tropical moist forests have already been reduced from their natural domain by more than 40 percent.[13]

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In North America and Europe, the forest area is roughly stable; in fact, the modernization of agriculture over the last half-century has allowed a considerable reversion of farm to forest. A slight increase in forest area is projected for Europe over coming decades, while a slight decrease may be in store in North America. In these regions, the challenge in the years ahead is less one of simply preserving forest lands than of balancing competing environmental, recreational, and industrial demands and of choosing appropriate timber-management techniques. Among less developed countries, China and South Korea stand out for having substantially increased their forested areas in recent times.

Throughout most of Africa, Asia, and Latin America, the forest area itself is shrinking and usually not according to any rational land-use plan. Areas that were densely settled long ago—such as the Middle East, parts of North Africa, the Andean region of South America, and most of China and South Asia—lost the bulk of their forests in ages past, so the absolute decline, if any, in closed-forest area today is not large even though the depletion of tree cover in and out of forests generally continues. But many developing countries, especially those in the humid tropical belt, are now experiencing rapid and massive forest destruction. According to one FAO estimate, the annual loss of forests in Latin America is five to ten million hectares, in Africa about two million hectares, and in Asia about five million hectares.[14] Even figures like these greatly understate the deforestation problem, for they reflect neither the massive degradation of timber and other biological resources occurring *within* many still-standing forests nor the

severe depletion of open woodlands and countryside vegetation that currently blights most Third World countries.

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In long denuded and more arid regions, the hardships imposed by a dearth of trees have long been felt. Now the combination of destructive logging practices and the ill-planned spread of cultivation is even pulling many seemingly timber-rich countries of the humid tropics toward forest-related economic and ecological crises. In late 1977, while pressing for the adoption of a new forestry policy, the Deputy Premier of Peninsular Malaysia shocked his compatriots by projecting that the region's once-lush forests would be severely depleted in just 12 years. He predicted that by 1990 the rate of timber production would not be adequate to meet domestic, let alone foreign, demand. Stringent new logging controls are being imposed in Thailand following the National Forestry Department's estimate that the country's forests are shrinking by 250,000 hectares a year, and that they will be virtually gone in 25 years if present logging and farming practices continue. (Thailand has a special problem with poachers of valuable tropical hardwoods; each year 30 to 40 forest guards are killed in gun battles.)[15]

Recent satellite pictures of the Philippines, traditionally a major timber exporter, indicate that forests now cover just 30 percent of the country, though the government feels a forest cover of 46 percent is desirable for economic and environmental reasons. If existing logging patterns prevail, a consortium of Philippine research organizations has concluded, all original old-growth forests will have been cut down by the year 2000 and projected timber supplies from second-growth forests and plantations will not suffice to meet even domestic needs. Destructive increases in flooding and sedimentation have already been registered.[16]

Examining logging and agricultural trends in the timber-exporting zones of West and Central Africa, Reidar Persson believes it is "likely that all exploitable forests in West Africa and most of Central Africa (except Zaire) will be exploited a first time before the turn of the century with resulting impoverishment of the natural forests. In a number of countries future exploitation will have to decrease." Increasingly far from harbors and good roads, Africa's remaining virgin

forests will be expensive to exploit. Existing planting programs and natural regeneration are not nearly offsetting the pace at which prime export species are being depleted. Nor are plantations to meet the continent's own escalating needs for lumber, pulp and paper, and firewood being established at anything close to the needed rate.[17]

On a worldwide basis, the extent to which tree planting is offsetting forest losses is impossible to ascertain. What data do exist on reforestation and plantation programs often do not distinguish the restocking of existing forest lands from the extension of plantations to new areas. In a 1978 report, the FAO estimated the "current world planting programme" to be "about 4 million hectares a year." China and developed countries undoubtedly account for most of the total. Persson has recently estimated the planting rate in the developing countries, excluding China and Korea, to be about 650,000 hectares a year. The FAO's 1976 review of forest trends in Asia assumed that new planting in the region's developing countries, again excluding China, would total only 1.5 million hectares during the decade of the seventies.[18]

Given the alarm about forest losses and firewood scarcity that has recently been voiced by many governments and aid agencies, and the flurry of reforestation programs now being initiated, the planting totals are probably rising fast. Still, the current pace of tree planting looks pitifully slow when compared with the pace of forest loss, and slower still when compared with the gargantuan demands that will be placed on the world's forests in the decades to come.

The Sources of Deforestation

In his keynote address to the Eighth World Forestry Congress, held in Jakarta in October 1978, FAO Director-General Edouard Saouma observed that the current rate of forest destruction in developing countries "is unacceptable, not so much as a percentage of forest total but because of where and why it is happening."[19] Too many of the trees being cut today are performing crucial environmental services for people and would be better left in the ground or immediately replaced. Too many forests are being logged in a manner that maximizes the immediate profits of a few but jeopardizes the long-term welfare of

the majority. The spread of agriculture, firewood collection, and timber harvesting are the principal immediate causes of forest losses. But behind these lurk more basic failures. Usually, uncontrolled deforestation is a symptom of a society's inability to get a grip on other fundamental development problems: agricultural stagnation, grossly unequal land tenure, rising unemployment, rapid population growth, and the incapacity to regulate private enterprise to protect the public interest.

The spread of agriculture in one form or another is by far the major cause of outright forest loss today, as it has been throughout most of human history. Most of the farmland in nearly every country was once at least moderately tree-covered. Although its extent is often exaggerated, some potentially arable land yet remains under forest in parts of Africa, Latin America, and Southeast Asia. Given the population increases in store for these regions, the conversion of much of this land to agriculture over the coming decades will be necessary and, in many cases, the best among feasible land-use choices.

However, the spread of agriculture is often characterized more by chaos and ecological destruction than by rationality, even when it is "planned" by governments. Politicians always find it easier to hand out unoccupied land than to redistribute proven farmland, however unequal the ownership of the latter may be. Even where national forest resources are deficient, as in India, governments can succumb to public pressures to turn needed forest lands over to cultivators. In the tropical rain forests, where in many cases little is known about soil conditions and potentials, both legal and illegal colonists are trying to carve farms out of the jungle. But much tropical land colonization, as U.N. analysts observed a decade ago, "is indiscriminate . . . an ill advised use of the land. It is merely a process of trial and error. Very often the chosen forest land cannot support permanent agriculture. When soil fertility is lost, cultivation is abandoned and the land is often grazed. The bare soil will frequently return to forest, unless, as is often the case, it is first destroyed by erosion."[20]

Particularly in Central and South America, increasing areas of tropical forest have been cleared to create grazing lands, another transition that

"Usually, uncontrolled deforestation is a symptom of a society's inability to get a grip on other fundamental development problems."

is sometimes unsustainable and that is frequently of dubious social value. Having largely given up on its grandiose plans to populate the Amazon Basin with peasant cultivators, the Brazilian Government has granted huge concessions in the region to both domestic operators and foreign corporations to raise cattle. New pastures account for a good share of the million hectares of forest that disappear in Brazil's portion of the Amazon Basin each year. Likewise, large landowners in Venezuela are transforming forest into pasture; while in Costa Rica, as elsewhere in Central America, virgin forest is rapidly giving way to pastures created by cattle ranchers anxious to cash in on the lucrative U.S. export market. Pointing to massive soil erosion on denuded slopes and to the widespread deterioration of soil structure and quality, ecologist Joseph Tosi has estimated that more than half the pasture land in Costa Rica is not suited to this purpose. Ironically, even as Costa Rica's cattle production has soared, its domestic per capita beef consumption has fallen by half in the last 15 years; the economic returns from the expanding cattle industry are not widely shared.[21]

Much of the blame for forest destruction is often laid on the shoulders of shifting cultivators—those who slash and burn a clearing in the forest, grow crops for a few years until soil fertility dissipates, and then move on to clear a new patch. However, while itinerant farmers are indeed major agents of deforestation, it is important to differentiate among the various sorts of shifting cultivators and the soundness of their methods.

As evolved over the ages in Africa, Asia, and Latin America, sustainable systems of shifting cultivation entail lengthy fallow periods during which soil fertility is restored and trees regrow on the cultivated plots. Some practices just now being developed and pushed by tropical foresters, such as agro-forestry systems in which trees and crops are rotated on the same land, are in a sense efforts to build the ecological soundness of traditional shifting cultivation into new forms of continuous land use. Today, many traditional peoples in areas such as the Amazon Basin, Central Africa, and the more remote parts of Southeast Asia are still practicing shifting cultivation in harmony with nature. It is when such farmers get hemmed in by logging companies, the spread of plantations, or other incursions of modern so-

ciety that they are portrayed as enemies of the forest. In addition, as human numbers in a given region rise and the free forest area about them shrinks, fallow cycles are shortened to the point where trees have no chance to regrow. Aerial surveys of the dense rain forest of the Ivory Coast, for example, showed a reduction in forested area of 30 percent between 1956 and 1966, a consequence of shifting cultivation by a quickly expanding population.[22]

Many of the "shifting cultivators" wreaking the greatest forest destruction today are not traditional practitioners of this art at all. They are rootless, landless people, often squeezed from their homelands by unequal land tenure or population growth, who are struggling to make what living they can amidst unfamiliar ecological conditions. In Indonesia, for instance, many of those who have migrated from crowded Java to the outer islands have found continuous cultivation of the land unworkable, either because the soils are not appropriate or because promised technical assistance has not materialized. Many migrants have become new shifting cultivators who will permanently reduce the timber and wildlife resources of the areas over which they spread. In Venezuela, which has a high rate of unemployment and rising numbers of landless peasants, 30,000 families, most of them practicing shifting cultivation, are living within national parks, forest reserves, and other supposedly protected areas. An influx of shifting cultivators in the watershed above the Panama Canal is, by causing increased siltation of a crucial reservoir, jeopardizing both the Canal's future utility and Panama City's water supply—prompting a major new U.S./Panamanian program of reforestation, agro-forestry, and improved land management.[23]

Outside the humid tropical zones, the last extensive forests in many Third World countries are on the steep slopes and more remote reaches of mountains. Agriculture nearly everywhere has traditionally been concentrated on the plains and valley floors, and with good reason, for severe erosion and other ecological calamities often occur when slopes are left unprotected by vegetation. Yet today, pushed by the lack of access to land or jobs in the plains, cultivators are moving up mountainsides in many parts of Africa, Asia, and Latin America, clearing forests as they go.

Mountain farmers also gather firewood, small timber, and fodder from remaining forests. In Nepal—to provide an extreme case, yet one of importance to hundreds of millions of people because of the country's ecologically strategic location—the spread of farming and the collection of fuel and fodder have combined to reduce the forested area in the hill zone by 25 percent over the last decade. In 1976, a Nepalese research group concluded that a continuation of existing trends would result in the complete disappearance of accessible forests in the hills within 15 years—which the researchers themselves labeled a "doomsday forecast."[24]

Frequently a precarious and futile business for those who practice it, mountainside farming and the associated deforestation also affect the welfare of those in farms and cities downstream by increasing flooding and the siltation of rivers, reservoirs, and harbors. Citizens in dozens of countries—Colombia, India, Indonesia, Nepal, Nigeria, Pakistan, the Philippines, and Tanzania, among others—are today learning the same lesson that a surge in the severity of alpine torrents taught Europeans a few centuries back: humans strip mountainsides of trees at great risk to their own well-being.[25]

Firewood collection is a second important contributor to forest depletion. About half of all the wood cut in the world each year is burned as fuel, mainly by the one-third of humanity who still rely on firewood for cooking and heating. At least 1.5 billion people burn anywhere from one-fifth of a ton (in extremely poor and wood-short areas such as India) to well over a ton (in parts of Africa and Southeast Asia) of wood a year, putting an awesome pressure on the world's vegetation that is often ignored in official statistics. Fortunately, all this demand does not translate into deforestation; where the balance between tree growth and human numbers permits, peasants usually collect dead wood and scraps from trees cut for other purposes. Dense forests can produce a lot of burnable material without any live trees being felled. In some areas, such as Java, home gardens supply a good share of family firewood needs.[26]

Elsewhere, however, the gradual depletion of woodlands is a common result of the daily foraging of villagers. In Madhya Pradesh, which

holds more forest than any other Indian state, a recent survey revealed that the annual cutting of firewood and small timber exceeded new growth in 26 of 45 districts. If current trends persist, 16 of these deficit districts will be virtually bereft of trees within 20 years; more than half the state will be devoid of trees within 50 years.[27] In combination with heavy grazing, the cutting or disfigurement of scattered tree cover by fuel-gatherers in the more arid zones was cited by the 1977 U.N. Conference on Desertification as a major contributor to the spread of desertlike conditions.

The outright destruction of living trees to meet fuel needs occurs most commonly around cities and towns, where commercial markets for firewood and charcoal exist. Well-organized syndicates bring fuel by truck, donkey cart, and camel into cities like Ouagadougou in Upper Volta and Niamey in Niger; the widening circles of treeless desert around these and other West African cities testify to the lack of concern for the future shown by those plying this trade. In Sudan, forest rangers have accosted armed crews as they fill trucks with illegally cut wood that will be converted into charcoal for sale in the cities; shootouts reminiscent of the American Wild West have sometimes occurred.[28]

Rising firewood prices can tempt desperate individuals as well as greedy big-time entrepreneurs into cutting live trees. Near Bhopal, the capital of Madhya Pradesh State, the forest department has granted people the right to collect headloads of dead wood in the forest reserves for personal use. Yet throughout these reserves are signs that "dead wood" is being actively manufactured: trees with their bark girdled and trees axed outright. Live trees become "personal" headloads of dead wood that then find their way into city markets; as a consequence, nearby forest reserves are gradually being reduced to scrubland. On the outskirts of Bara, a town in semiarid central Sudan, live hundreds of former nomads who lost their herds to drought and now eke out a living selling wood and charcoal. Much of the wood they sell is illegally cut from dwindling stands of valuable gum-arabic trees in the region. Describing their destructive activities to Norwegian geographer Turi Hammer Digernes, the wood sellers were surprisingly frank: "We take trees belonging to other people. We cut

"Well-organized syndicates bring fuel
by truck, donkey cart, and camel
into cities like Ouagadougou
in Upper Volta
and Niamey in Niger."

them when they are too young. We never pay any tax. . . . We must live from something. What else can we do?"[29]

On a worldwide basis, the operations of the lumber and forest-products industries do not rival the spread of agriculture as a direct cause of reduced forest area, though the two forces often work in tandem. Still, improperly managed logging is unquestionably contributing to the depletion of the earth's forest resources, and sometimes to an actual decline in forest area. Where irresponsible timber concessionaires clear-cut mountain slopes, as they have in parts of Pakistan, Afghanistan, and other countries, the chances for a restoration of tree cover can wash away with the topsoil during the first violent rainstorm.[30]

In temperate zones, where tree growth to marketable size usually takes many decades, heavy cutting can cause a lengthy reduction in wood output even from an area that remains visually covered with trees. Although they have been restocked, for instance, large corporation-owned tracts of conifers in the U.S. Northwest are entering a quarter-century of reduced wood production as a result of past cutting. The companies and communities whose livelihoods are based on these lands are now urging an increase in timber harvests in nearby national forests, but this would in turn conflict with recreational demands on the latter and might, some fear, even endanger their long-term productivity. Large forest areas in Canada and the Soviet Union are being logged at rates surpassing new growth. If planned increases in output are to occur, either replanting and more intensive management must be instituted on already-cut lands or loggers must move to ever more remote forests. In either case, the real costs of timber will rise.[31]

Particularly in the Third World, logging sometimes depletes or destroys resources of great daily value to people living in or around the forest, while the profits and consumer benefits of the operation are mainly enjoyed by people in faraway capital cities or foreign lands. In evaluating the economics of timber operations, governments can easily overlook the multitude of products and services the forest renders to local people; in some cases, their combined value may rival

or surpass the value of the forest as timber. But most of the nontimber benefits do not accrue to those who hold power over the destiny of the forests.

In the Himalayan hills of the Indian state of Uttar Pradesh, a people's movement has appeared in the seventies to fight what it sees as the damage to the local residents' interests caused by timber operations. The state government grants logging contracts by auction to private timber firms, which carry out the extraction of timber from the forest reserves. Some of those whose lives are intertwined with the forest, and who directly suffer the ill effects of environmentally unsound harvesting practices, drew attention to their plight by grabbing hold of trees they wanted to preserve as lumberjacks approached. Known as *Chipko Andolan* (the movement to hug the trees), the group aims both to protect ecologically vital trees and to spur more democratic control over the practice of forestry in that region.[32]

Logging in humid tropical forests—much of which has been done by multinational corporations—usually involves not clear-cutting but the "creaming" of the forest's small proportion of commercially valued species. However, the process of cutting and removing selected trees amid dense foliage and on delicate soils usually wreaks far more destruction of vegetation and wildlife than the bare statistics of extracted timber would suggest. One Indonesian study revealed that logging operations damaged or destroyed about one-third of the trees left behind.[33]

Apart from the responsibility with which it is practiced, logging in many tropical forest areas of Southeast Asia, Central and South America, and Africa is contributing inadvertently to the permanent loss of forests. Wherever loggers build roads and settlements, other people follow. With or without government approval, cultivators move along new logging roads and into newly logged areas, hoping to put down roots. The widening clearings and telltale smoke plumes of slash-and-burn cultivation are normal sights around new roads throughout the humid tropics. When these farms fail, they are sometimes replaced by cattle pastures or by useless, tenacious grasses.

Even when it is not followed by cultivation, logging can leave the forest permanently bereft of the more valuable species. In Kalimantan,

the homeland of Indonesia's lucrative timber boom, logging firms are supposed to follow a "select-fell" system in which only larger trees of the desired species are cut, and then only from areas in which a set number of smaller specimens can be left to replenish the stock. In theory, such a system would permit the logging of a given area every 35 years without depletion. After studying growth patterns and species changes in logged-over areas, however, two scientists from the Weyerhaeuser Company, which operates a concession in Kalimantan, wrote that "whereas many S.E. Asian foresters feel that the select-fell system of tropical rain forest silviculture will successfully perpetuate yields of desired species, others are less convinced." In any case, they go on to note, a 1977 study of the Kalimantan operations of nine different companies revealed that "none was leaving the required 25 select crop trees per hectare and, indeed, on much of the area there were not sufficient trees at the start to comply with the regulation."[34]

The notion that these areas will be ready for another valuable harvest in 35 years thus appears to be wishful thinking at best, or a convenient lie at worst. Of the scores of Indonesian, Japanese, Philippine, Korean, American, and other companies cutting and exporting Indonesian timber, Weyerhaeuser is the only one that is even experimenting with plantations on a small portion of the land it logs. Only a few companies are building sawmills so that more of the jobs and profits associated with the use of its timber can be kept in Indonesia. The companies and many individual Indonesians are getting rich off the timber trade, and the national government is taking in huge royalties that in theory can help finance the nation's economic development. But as log output begins to fall off, many Indonesians may begin wondering how much of lasting value the majority have received from the feverishly paced, largely unregulated exploitation of what is, under current modes of extraction, virtually a nonrenewable natural resource.

Despite the extensive degradation of tropical forests, a rising share of the world's wood and fiber supplies will have to be produced in the tropics, where year-round sunlight and warmth permit much faster growth than is possible in temperate zones. Even as current logging

patterns are depleting the major commercial species of many tropical forests, technologies are being developed that use virtually all species, if not for lumber then for reconstitution as particle board, fiber board, and paper. In several tropical countries, operations that clear the land of nearly all vegetation, making wood chips out of most of it, are already under way.

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Like [illegible] new technologies, "all-species use" is a two-edged sword; because of its uncertainties and dangers, forester S. D. Richardson has called its adoption a "Faustian bargain."[35] Used carelessly, it can become a source of deforestation of a sort much more harmful to the future than traditional logging practices are. Most of the nutrients in rain-forest ecosystems are contained in the vegetation rather than the soil. Remove the biomass, as all-species use does, and the possibilities for future tree growth will be uncertain in many areas. Clearings are supposed to be followed by replanting, but little is known yet about the long-term productivity of intensive tree plantations on deforested rain-forest lands; and, unless governments show more regulatory perseverance than they have in the past, there is no guarantee that serious reforestation efforts will always follow denudation in any case.

On the other hand, more intensive use of smaller areas in the tropics offers a means of breaking the current destructive pattern of an extensive creaming of prime species followed by a reckless spread of cultivation and grazing. The preservation of large natural-forest reserves will not be possible without greatly intensified production in some selected areas. Implemented carefully and responsibly, say botanists Jack Ewell and Louis Conde, all-species use could "provide a means for taking the pressure off of other lands while permitting developing tropical nations to tap the high potential productivity of their forests." If forest clearing is combined with sustainable tree planting, the tropics can supply prodigious amounts of wood and fiber; man-made forests in tropical zones can produce five to ten times the wood of those in temperate zones.[36]

All in all, a host of forestry measures that could slow the pace of forest loss await wider implementation. With agro-forestry systems,

shifting cultivators can make a good living as they rebuild rather than destroy forest resources.[37] Intensive plantations in selected areas can supply a large share of needed wood and fiber, freeing other areas from the chainsaw. Woodlots around villages, and in and around cities, can provide fuel, poles, and a stable and pleasant environment to those now suffering shortages of each. More intensive management of North American and Soviet forests could boost their output considerably. Logging practices can be regulated to protect the interests of future generations, while waste in the post-harvest processing of timber can be cut. To be sure, technological gaps can be identified that hamper many of these lines of attack; but in general, the frontiers of technical knowledge in forestry lie far beyond the state of its implementation.

Essential as they are, such forestry measures alone will not be enough to solve the deforestation problem. As this review suggests, many of the underlying sources of deforestation originate outside the scope of forestry per se. In order to halt the destructive spread of cultivation, national development patterns must provide the destroyers with alternate ways to feed themselves; in particular, crop yields and employment must be boosted on the lands best suited to farming. Sound forestry policies can contribute to these efforts but broader decisions on investment priorities, land tenure, and the choice of technologies will be even more critical.

Woodland depletion by firewood gatherers can be greatly mitigated by tree planting, but broader attention to rural energy needs, appropriate alternative energy sources, and national energy priorities is also necessary if more hospitable rural environments are to be rebuilt. The conservation of forest products—by the poor through the adoption of efficient wood stoves, by the rich through increases in paper recycling and reductions in wasteful wood uses—is another part of a long-term solution to the forest problem that requires a broad social commitment. Underlying all the sources of deforestation to varying degrees is, of course, human population growth; more people demand more firewood and farmland in some countries, and more veneer furniture and unspoiled wilderness in others. The sooner population growth slows, the brighter the prospects will be for preserving forests ample

enough to meet both environmental and economic requirements. A vast amount of tree planting is essential over the coming quarter-
26 century, but its benefits will be undercut if the deeper roots of deforestation are not eradicated too.

The Price of Inaction

What are the full economic consequences of uncontrolled deforestation and forest-product scarcity? Curiously, although substantial literature exists on the economic gains possible through the exploitation of forest resources, virtually none exists on the economic consequences of a failure to put forestry on a sustainable footing. A better understanding of the price of inaction would cause many national planners to give higher priority to the forestry sector.

One outcome of a nation's forestry shortcomings can be a rising dependence on imported forest products. Already most Third World countries are, despite high natural growing potentials, net importers of forest products, particularly paper (the large-scale production of which requires both fiber and sophisticated manufacturing plants). Global trade data show the developing countries as a whole enjoying a slight positive balance in forest-product trade. However, if the export proceeds of just four tropical timber exporters—Indonesia, Malaysia, the Philippines, and the Ivory Coast—are removed, the developing world suffered a net trade deficit in forest products of $2.4 billion in 1976.[38]

Trade-deficit figures do not come close to capturing the negative social impacts of wood scarcity, some of which are acutely felt by low-income citizens even in timber *exporting* countries. For one thing, the major forest products used by most poor-country residents never enter the market economy; when fruits or firewood become scarce, people either do without or they switch to noncommercial alternatives rather than to imported goods. For another, foreign exchange shortages, import restrictions, and high prices can hold a nation's wood and paper consumption well below the levels at which needs are reasonably satisfied.[39]

"An inadequate supply of forest products is already an inflationary force worldwide."

Thus in Pakistan, to provide an extreme case, the actual consumption of industrial timber is only about half what one would expect even considering the country's income level. Between 1965 and 1975, average per capita income rose by 27 percent; according to experience elsewhere, a comparable increase in forest-product consumption should have occurred, but none did. World Bank analysts point out that "although consumption and supply are obviously in balance, there is a considerable shortage of industrial wood in the country. This shortage is manifesting itself in a number of ways including sharply increasing prices, and substitution in a variety of end-uses such as concrete railway sleepers, steel transmission poles and steel furniture."[40] Concrete and steel, major timber substitutes everywhere, are themselves often scarce and expensive in the Third World, so they hardly provide a satisfactory solution to timber scarcity.

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With inflation now rampant nearly everywhere, the extent to which forest-product scarcity is one of its driving forces deserves close scrutiny. Mesmerized by their own analytical tools, modern economists often pay little heed to trends in the natural systems on which human activity is based.[41] Yet an inadequate supply of forest products is already an inflationary force worldwide, and appears certain to be even more of one in the coming decades.

The deepening timber shortage in Pakistan has been accompanied by astonishing rises in the price of domestic lumber. In the Rawalpindi market, one popular species that sold for 15 rupees a cubic foot in 1967 sold for 45 rupees in 1973 and 80 rupees in 1976. A simple board costs twice as much in Pakistan as in the United States, though the income of the average American is 46 times that of the average Pakistani.[42]

The pressure of demand on timber supplies has even promoted inflation in the United States, with all its forest wealth. A historical study of resource scarcity in the United States, conducted in the early sixties, found that forest products were the only major resource category for which proof of increasing scarcity—rising real prices—existed over the previous century. Between the 1870s and the 1950s, the real price of forest products multiplied two-and-one-half times.[43]

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In the seventies, U.S. wood prices have surged anew. Between 1970 and 1976, wholesale prices of lumber and wood products far outpaced the general inflation rate, rising annually in absolute terms by 10.4 percent and in real terms by 3.9 percent. The real price of softwood lumber, used in construction, rose by an especially high 7 percent a year. And further domestic timber price increases are certain. Recent U.S. Forest Service studies show that "the increases in prices necessary to maintain an equilibrium between projected demands and supplies are substantial—in the case of softwood sawtimber over 100 percent by the early 2000s. These increases are in real terms."[44]

One obvious consequence of timber-price inflation is the increasing cost of construction. From the mid-sixties to the mid-seventies, the average price of a new house in the United States climbed from $30,000 to $50,000; home-buying is becoming impossible for many Americans. Wood prices are only one of many factors pushing up house prices, since wood usually accounts for less than one-fifth of the cost of a new house. Yet the effects of timber availability on housing prospects cannot be ignored.

The social impact of timber scarcity on housing is especially pernicious in poor countries. In the booming cities of less-developed Asia, about three to four million housing units are being built each year. However, if satisfactory housing is to be provided for the region's urban residents, notes an FAO study, 15 million units must be built per year over the next two decades. Even if governments were to make a serious effort to meet this challenge, adequate wood supplies are unlikely to be available. Right now, the Indian state of Gujarat's ambitious plan to construct huts for landless laborers is being derailed by the paucity of raw materials. The program requires 25 million wood poles, but only 400,000 of these become available each year; and only 4 million bamboo stalks are produced a year although 765 million are needed.[45]

Soaring firewood prices are another inflation source. Almost everywhere commercial firewood markets exist, prices have multiplied over the last decade—in some cases faster than oil prices. In parts of West Africa and Central America, urban families spend one-fourth of their

"In parts of India, a family member must spend two days gathering a week's worth of wood."

income on wood or charcoal for cooking; it can cost more to heat the pot than to fill it. As market prices have outpaced the purchasing power of the urban poor, many state governments in India have had to establish special firewood depots that sell low-priced fuel to the poorest groups.

Firewood scarcity exacts other less visible burdens too. Many users do not buy wood, but the task of gathering it—which is often relegated to women and children—can become increasingly time-consuming, to the point where it is a real economic and personal drain. In central Tanzania, 250 to 300 days of work are required to provide the annual firewood needs of a household. In parts of India, a family member must spend two days gathering a week's worth of wood.[46]

As fuel becomes harder to find, people may cut back on essentials. In bitterly cold mountain areas families must do without the warmth of a nighttime fire and suffer the health consequences. The nutritional impact of firewood scarcity has not been well investigated; but in areas of West Africa and Latin America, people have recently been forced to give up one of their traditional hot meals a day. Peasants in Nepal and Haiti have cut back on their consumption of vegetables that require cooking.[47]

With firewood unavailable, rural people switch not to fossil fuels, which are often unavailable and always expensive, but to crop residues and dried cow dung. The resulting diversion of organic matter and nutrients from field to fireplace carries its own negative economic effects. According to J. E. M. Arnold of the FAO, some 400 million tons of cow dung are annually burned in Asia, the Near East, and Africa. Each ton burned means a loss of about 50 kilograms of potential grain output.[48]

Looking at Nepal alone, World Bank analysts recently calculated the costs of projected deforestation in terms of foregone food output. They figure that, in the absence of an adequate tree-planting program, the amount of additional dung that will be burned in the year 2000 will reduce grain production by about one million tons, worth more than $100 million at current world prices—this in a country where

undernutrition is already the norm and total grain production is only about four million tons a year. On a global basis, if the pace of village tree planting is not radically boosted, says John Spears, "by the turn of the century, at least a further 250 million people will be without wood fuel for their minimum cooking and heating needs and will be forced to burn dried animal dung and agricultural crop residues, thereby further decreasing food crop yields."[49]

Rising prices and outright shortages of paper have been yet another forest-related source of inflation and hidden hardships. Recent global surges in paper prices are the result of boom-and-bust cycles in the pulp-and-paper industry rather than of a shortage of wood for pulping. Still, the paper industry requires huge amounts of wood, and desired production increases in parts of the Third World will be severely constrained by the unavailability of raw materials. Breaking the Third World's costly dependence on unreliable paper imports will require the creation of forests as well as the building of the small-scale factories now being boosted by international agencies.[50]

The true costs of paper scarcity are hard to discern and probably incalculable. Paper in a society might be compared to baking soda in a cake: a small portion of the whole that is taken for granted when present yet sorely missed when absent. In the most economically advanced nations, the volume of paper used in packaging and bureaucracy may have reached the point of negative returns for efficiency, but a usage level well above that prevailing in much of the Third World is essential to good government and a healthy economy. In some countries, inadequate numbers are printed even of important planning documents out of concern for paper costs. Cardboard packaging is critical to most commerce. In India, the inadequate supply of packaging is seen as "a major constraint on the development of the export industry."[51]

Paper shortages also hamper communications and education. Back in 1974, a time of acute worldwide paper scarcity, an Indian official said that "schoolbooks haven't been available for the start of the term, and the cost of students' notebooks has more than doubled." Indian newspapers had to cut their average size, and suffered threats to edi-

torial freedom as the government rationed scarce paper supplies with politics in mind. Even in the United States, the doubling of newsprint prices in the seventies has contributed to reductions in the size and number of newspapers.[52]

The environmental consequences of unwise deforestation are seldom expressed in economic terms, but many of them directly influence economic output as well as human welfare in the broader sense. The refinement of analytical techniques for evaluating both the environmental benefits forests provide and the environmental results of continued forest losses would undoubtedly promote more stringent efforts to protect essential wooded areas and to reforest denuded areas. Decades of research have proved, for example, that the deforestation of watersheds can increase the severity of flooding, reduce streamflows and lead to the desiccation of springs during dry seasons, and increase the load of sediment entering waterways.[53] Yet most efforts to combat such problems have entailed engineering measures—dams, embankments, dredging—that address their symptoms but not their causes.

The exact contribution of deforestation to flood trends is probably impossible to pinpoint, but as flooding worsens in country after country, new attention must be given to land-use practices in watershed areas. In the fall of 1978, India suffered some of the worst flooding in its history: following two days of concentrated rainfall, 66,000 villages were inundated, more than 2,000 people drowned, and 40,000 cattle were swept away. Two states, West Bengal and Uttar Pradesh, lost a total of $750 million in crops. Many Indian officials are beginning to wonder whether their chronic flood problems can be ameliorated without a restoration of forest cover in the increasingly denuded hills of Northern India and Nepal.[54]

The costs of accelerated reservoir sedimentation are not hard to understand. Studies of 17 major reservoirs in India reveal them to be silting up at three times the expected rate, apparently because of the deforestation of upstream areas. So valuable is water in arid Pakistan that the expensive new Tarbela Dam was built with full knowledge that the heavy silt load of the Indus would render it virtually useless

in 50 years. Because of severe erosion, linked to deforestation, the Ambuklao Dam in the Philippines has an expected economic life of
32 just 32 years. The list of siltation horror stories from every continent is long, but the point is perhaps best made by an example from Ecuador. A U.N. report showed that a $1 million program of reforestation and on-farm soil conservation in the Poza Honda Basin would reduce sedimentation enough to extend the life of the 1971 reservoir by 25 years—and that each of these additional years would bring $2 million in benefits. Yet, observes hydrologist Samuel Kunkle, "many river basin projects continue to neglect upstream erosion control, and fail to recognize that the erosion control frequently costs less than the sediment damage."[55]

In preparation for the 1977 U.N. Conference on Desertification, analysts estimated that the cumulative degradation of rangelands and nonirrigated farmlands in drier zones is holding their combined annual productivity more than $12 billion below its potential. No one can say just what portion of this loss is due to the destruction of trees, which hold down wind erosion, influence local temperature and humidity, and in many cases replenish essential soil nutrients. Certainly it is not small, as the well-documented productivity gains achieved by windbreak planting in semiarid zones suggest. Soviet wheat yields rise 20 to 30 percent with shelterbelt protection; Southern California citrus orchards produce nearly twice as much when they are protected by windbreaks.[56]

Some of the environmental costs of current forest trends are by nature incalculable, but are nonetheless massive. Should the clearing and disruption of tropical rain forests continue at recent rates, ecologists warn, thousands and possibly hundreds of thousands of plant and animal species, many of them not yet named, will become extinct. As Norman Myers points out, it is a statistical certainty that numerous sources of beneficial drugs, foods, and industrial products will be unknowingly wiped out. The full ecological repercussions of such an unprecedented biological massacre cannot be predicted; but it will certainly constitute an irreversible distortion of the evolutionary process. The protection of selected biologically rich tropical areas in their

"Because of severe erosion, linked to deforestation, the Ambuklao Dam in the Philippines has an expected economic life of just 32 years."

natural state is one of the overriding conservation issues of the late twentieth century.[57]

Scientists studying the rising level of carbon dioxide in the atmosphere, which is likely to lead to global climatic shifts, have added a new reason for concern about the loss of tropical forests. A vast amount of carbon is stored in the extensive forests of the tropics, particularly in the massive older trees of virgin forests. The release of that carbon through deforestation and burning could add significantly to the atmosphere's carbon dioxide. Some, such as biologist George Woodwell, believe that deforestation may already rival fossil-fuel burning (traditionally thought to be the overwhelming human cause of the carbon-dioxide increase) as a source of atmospheric carbon. Whether or not that is true, the potential for continued forest losses to contribute to climatic disruption clearly exists.[58] Concern for the economic prospects of deforested and wood-importing countries aside, issues like species extinction and climatic change make the fate of the world's forests a matter of consequence to people everywhere.

Forests By the People, For the People

The challenge facing world forestry is not just to halt deforestation and to plant enough trees to satisfy commercial and environmental needs. From a social perspective, top priority must also be given to meeting the elementary forest and wood needs of the poorest one-third of humanity. And with forest products, as with food, merely growing more produce is not necessarily sufficient to eliminate deprivation. Who does the producing and how the benefits are distributed are equally crucial considerations.

Today, new notions about the purpose and practice of forestry are percolating through Third World forestry circles and international aid agencies. In essence, some foresters are beginning to see the necessity of taking forestry outside the forests—of involving people throughout the countryside in growing trees to meet their own requirements as well as to protect the land off which they live. Forestry carried out by deprived people themselves can vastly augment global forest resources even as it directly benefits those in greatest need.

But community forestry, as it is becoming known, will not materialize on the needed scale without major changes in the way foresters conduct their business.

Traditionally, and not surprisingly, most national forest departments have concerned themselves almost exclusively with the areas officially designated as "forest." Foresters have applied what silvicultural knowledge and economic management they could to these wooded reserves, and have maintained guard forces to protect the trees from wood poaching by fuel-starved peasants and unscrupulous merchants. Consistent with this spatially narrow vision, the bulk of official forestry investment in poor countries has been devoted to large-scale timber exploitation for industrial, urban, and export markets. Where forests are especially rich they have often been given over to multinational firms for cutting and export.

Meanwhile, the small-scale, spatially diffused forestry needs of the rural majority—firewood for cooking and heating, poles for construction, fodder for livestock, and trees throughout the countryside for the protection of soils and the production of foods and other goods—have often been virtually ignored. As Jack Westoby, a longtime social critic of international forestry, puts it, "In precious few countries have the energies of the foresters been bent upon helping the peasant to develop the kind of forestry that would serve his material welfare."[39]

Unfortunately, in forestry, as in more general economic development, the fruits of large-scale, centralized investments seldom trickle down to the poor. Past patterns of forestry development have brought little benefit to the half of humanity inhabiting rural villages. As practiced to date, forestry has often accentuated rather than narrowed the gaping social divisions that exist within most Third World countries. Similar perceptions about the parallel failures of many industrial and agricultural projects to benefit the poor have become commonplace among more enlightened economists. Now the rhetoric of the forestry profession, which has never been part of the mainstream development establishment in any case, is catching up. Perhaps not coincidentally, the infusion of a socioeconomic consciousness into forest-

ers' thinking is occurring just as the importance of trees to economic development is finally beginning to be appreciated by economists.

Even without the inspiration provided by the recent conversion of many economists to people-oriented development, foresters would have been drawn toward people-oriented forestry by the sheer pressure of events. Reports of the social and ecological manifestations of past myopia—of spreading firewood and timber scarcity, of deepening soil erosion and falling soil fertility, of record floodwaters running rampantly off denuded hills—are now common fare in Third World newspapers and are creeping into the professional journals. Even the achievement of the foresters' traditional objective, the sound management of forest reserves, is being visibly undermined, for where acute wood scarcity prevails the protection of woodlands from the desperate and the greedy is all but impossible.

The elements of community-based forestry strategies that could help reverse these dire trends can be spelled out easily enough; in theory, probably no country lacks the physical resources to meet its most urgent rural forestry needs. Villages virtually everywhere have unused or misused lands on which fast-growing woodlots can be planted. In watersheds, the raising of crops, trees, and livestock can be integrated in new ways that protect soils as they provide extra benefits for people. Agro-forestry systems can give shifting cultivators a stable, productive life. Idle lands along roads and canals and around fields can be planted to trees that produce food, fodder, timber, traditional medicines, and assorted industrial raw materials as well as a more hospitable environment. Cheap, efficient cooking stoves can be disseminated that cut family wood-fuel needs in half. Participatory forestry, with the profits if not the products widely shared, can even be adapted to industrial wood production—as in the Philippines, where small-holder farmers are supplying timber to the paper industry; and in Oakland, California, where a citizens' group plans to grow marketable tree products on vacant city lots.

Although the list of potential community forestry activities can be extended, the problem is not so much what to do as how to do it. To

an outsider, prompting rural communities to grow some badly needed trees may not seem like such a tall order. But as the experience of countries such as China and South Korea that have already implemented participatory forestry on a wide scale demonstrates, actually doing so requires radical changes in the attitudes and activities of governments and aid agencies, and reforms in villagers' social organization and land use.

Foresters, like development planners generally, are used to running things from above. What contact they have had with villagers has usually been in their roles as policemen, denying destitute people access to protected lands and wood. Antagonism between peasants and forestry officials is commonplace throughout the Third World; tales of murdered forest guards are not rare.

Yet if experience and common sense tell us anything, it is that community forestry cannot be imposed from above and carried out in the face of a hostile population. New forms of land use impinge upon, and are influenced by, the daily activities of everyone. When the local people are not active participants in and supporters of a project, saplings have a way of disappearing overnight. With fodder usually as scarce as firewood, uncontrolled goats or cattle can quickly ruin a new plantation even when disgruntled peasants, facing the alternative of a lengthy hike to collect fuel, don't covertly cut the saplings themselves.

Community involvement, then, is not just an ideologically appealing goal; it is a practical necessity if rural forest needs are to be met. A recent effort to establish 500 hectares of village woodlots in Niger, for example, failed because "as fast as the trees were planted, the village people either pulled them out or allowed uncontrolled grazing to take place." This debacle occurred, concluded John Spears, because villagers "had not been involved in formulating the project and because they perceived the village woodlot area as a traditional grazing ground." Likewise, an effort to preserve some natural forest within a resettlement area in Colombia failed "because the settlers themselves regarded the area as being better suited to agriculture than forestry and they forcibly occupied the protected forest area."[60]

Popular participation is important for economic reasons too, for in most countries the costs of the needed plantings and upkeep would be prohibitive if local residents did not pitch in generously with their labor. The high cost of plantation development in Brazil, which has chosen to subsidize commercial plantations by large landowners and corporations rather than to pursue community forestry, stands as a warning on both economic and social grounds to other developing countries, most of which are far poorer than Brazil. Since 1967, three million hectares of plantations, mostly fast-growing eucalypti and pines destined for pulp mills, have been established. A valuable resource has been created but at an extraordinary price: tax subsidies have averaged $500 to $820 a hectare, with the public subsidy over 11 years totaling $1.8 billion. "Despite relatively cheap labor," writes U.N. economist M. K. Muthoo, the plantation program has involved "one of the highest costs in the world of creating man-made forests." The program has widened socioeconomic inequality too: 92 percent of the plantations are over 100 hectares in size, and the bulk of them are in the country's richest regions.[61]

For bureaucrats accustomed to giving orders, and to worrying more about science than sociology, the necessary handing down of authority to the people can be as personally painful as it is institutionally difficult. Several speakers before the October 1978 World Forestry Congress, whose theme was "Forests for People," stressed the need for reforms in the structure of the forestry profession itself. In what amounted to an admission of the profession's past neglect, Edouard Saouma, Director-General of the FAO, said that knowledge about community-based forestry "is still in its infancy." It "introduces problems which are far removed from your traditional training," he challenged the 2,000 delegates in Jakarta. "Above all, it means dealing with people and the priorities they give to their various needs." Along similar lines, Charles Lankester, chief forester with the U.N. Development Programme, observed that "foresters have preached at the people too much; now we are realizing that we must work *through* the people instead."[62]

Pushed by economic necessity and pulled by the spread of egalitarian ideas, some governments and aid agencies are beginning to change

their forestry plans. The FAO has initiated, with the financial support of the Swedish Government, a major program of research and education under the theme of "forests for local community development." The World Bank, the world's largest aid giver, has in a recent forestry sector policy paper announced its intention to multiply its support for such activities as village woodlots, farm forestry, and environmental rehabilitation. A new International Council for Research on Agro-Forestry, directed by the noted forester K. F. S. King, has been set up, mainly with Canadian aid money, in Nairobi. The U.S. Congress has directed the Agency for International Development to give new attention to forestry in its rural development programs, while AID and the U.S. State Department have together sponsored an unprecedented strategy conference on tropical forestry problems. Top foresters and even national political leaders all over the world are beginning to talk of the need to integrate forestry into rural development in new ways.[63]

Welcome as it is, this belated shift in attitudes among national officials and aid agencies provides no guarantee that community forestry will take off with the required speed. In the words of Jack Westoby, making trees serve people "is not simply a matter of gearing the development establishment towards new objectives." Government bureaucracies everywhere are notorious for their resistance to retooling, particularly when the proposed changes seem to involve a loss of customary authority and elite status. Forest departments—or other agencies if foresters cannot adapt—need to provide "barefoot foresters" who will worry less about the elegance of silviculture and more about how peasants' cows will be fed, how cooking stoves might be redesigned to conserve firewood, and how small farmers whose economic horizons extend only to the next harvest can be persuaded voluntarily to plant trees for the future. Furthermore, the needs and potential contributions of women—as gatherers and users of wood and as possible growers of wood—have been badly neglected virtually everywhere.

Perhaps the greatest impediments of all to community forestry are the local social and economic institutions that, in many poor countries, perpetuate the rigid stratification of social classes and the severe

"Community forestry is not a technology; it is a process of social change that requires the continuous participation of whole communities in planning and problem-solving."

exploitation of those on the bottom. Community forestry is not a technology; it is a process of social change that requires the continuous participation of whole communities in planning and problem-solving. It requires people to shift from an individualistic to a cooperative state of mind in spheres of life where communalism has not usually been the norm, at least in recent history. People must willingly give up land-use practices and privileges to which they have long been accustomed. Such a process of cooperative behavioral change, never easy to bring about anyway, is especially unlikely where grossly unequal land tenure and marketing systems insure that a powerful minority will capture nearly all the benefits of any economic gains.

Initiating community forestry, then, can require grappling with all the interlocking social, economic, and political problems that add up to underdevelopment. At the same time, the process of creative community action that successful village forestry requires is the essence of what real development is all about: communities learning to solve problems, to create better lives for their members, to become more self-reliant. Ironically enough, forestry, long the neglected stepchild of economic studies, could in some countries turn out to be the catalyst of meaningful development.

Community Forestry Successes: China and South Korea

Spreading wood scarcity and land degradation have not gone totally unnoticed by governments. Scattered attempts at forest-building have been made over the years, with occasional local successes. But the overall record is a dismal one: millions of seedlings have been planted in the Third World only to be uprooted by people or nibbled to death by livestock within a few years.

Brightening this generally dull picture has been the example of the People's Republic of China. Although outsiders have enjoyed no surfeit of documentation about China's forestry programs, enough has filtered out to generate widespread interest in, and even awe of, the country's achievements. Despite many false starts and technical mistakes, the Chinese appear since mid-century to have reversed the

progressive landscape deterioration of five millenia and to have mitigated wood shortages of astounding proportions.

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Reidar Persson estimates that from 30 to 60 million hectares of new forests--including those planted for environmental improvement and those meant to supply village or industrial wood needs—have been successfully established in China over the last quarter-century. Chinese officials have told recent visitors that the proportion of their national land area in forest has been increased from 5 percent in 1949 to 12.7 percent in 1978, implying an increase of 72 million hectares. Combining strong central political support for tree planting with mass mobilization of rural communities for implementation, the continuing Chinese forestry effort has inspired a great deal of thought elsewhere about community forestry's possible designs and accomplishments.[64]

While the specific patterns of China's program are not likely to be duplicated, China has reaffirmed the ability of humans, when purposefully organized, to overcome extraordinarily severe environmental problems. In his influential 1948 book, *Road to Survival*, conservationist William Vogt had declared China beyond hope of reclamation. "Millions are going to die," he wrote, as "tragic sacrifices on the twin altars of uncontrolled reproduction and uncontrolled abuse of the land and resources."[65] In the ensuing 30 years, the Chinese Government has, in fact, faced the dangers of rapid population growth and mounted one of the world's most aggressive birth control programs. Yet China has also developed the capacity to sustain a population nearly twice the size of that which drove Vogt to despair, and, according to reports of a number of visiting physicians, has eliminated widespread malnutrition in the process. Combined with broader social reforms, the rebuilding and enhancement of the life-supporting capacity of China's landscape—a process to which community forestry has been a key contributor—stands as a signal achievement in modern ecological and social history.

Because of the depth of the Chinese political revolution, and China's seemingly unique ability to mobilize huge numbers of people to accomplish tasks, foresters elsewhere have tended more to admire

China's physical achievements in forestry than to think of emulating them. Outsiders have often viewed the country's accomplishments in areas such as forestry as feasible only within China's particular political and cultural context. Fortunately, however, examples of successful community forestry in other developing countries are now becoming more widely known. If neither the scale nor the political framework of tree planting in other countries is likely to match China's, opportunities for successful community forestry do exist wherever governments are willing and able to push for needed reforms in bureaucratic practice and rural social organization.

The dramatic forestry success story of the seventies, it now appears, is in South Korea. A mountainous country long known for its barren hills, rural fuel scarcity, and severe soil erosion, South Korea has joined China on an elite list: countries where people have been reorganized to reforest their landscape. In fact, if the reports trickling out are anywhere near accurate, South Korea has, in relation to its size, reforested more land more quickly than China has.[66]

By the early seventies, following decades of imperial occupation by the wood-short Japanese, years of vicious civil war, and the constant pressure of a dense rural population relying mainly on wood for fuel, South Korea's forest picture was grim. Huge timber imports were needed to supply the domestic-lumber and plywood-export markets, while fuel collection—the heart of the nation's forestry crisis—was destroying the rural environment. In order to get through one of the Korean peninsula's cold winters, the average rural family burned more than four tons of wood, crop residues, and other organic matter. Though most of the forests surrounding villages stood on privately owned land, peasants had a traditional right to collect free fuel from them. Hence the landowners, most of whom held only a few hectares, lacked any incentive to replant their lands even when they had the capital and technical ability to do so, which most did not. A 1969 U.N. report described some of the consequences:

> There is a critical need for fuel for heating and cooking, which causes people to cut grass, seedlings, shrubs and tree branches, and to rake the ground of all leaves, litter, and other burnable material.

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> Raking litter from the hillsides is one of the principal causes of soil erosion in Korea, since it removes ground cover needed for organic matter and for protection of the soil. In addition to litter raking, trees are deprived of much of their growth potential by excessive removal of branches. Seedlings are also yearly victims of the farmers' sickles during the grass harvest.
>
> No forestation or erosion control treatment will solve the present uplands erosion problem as long as these present abuses continue. It is obvious that just the yearly planting of a great number of trees is not, by itself, the solution.[67]

South Korea's forestry problems, then, were rooted in longstanding cultural practices and tied to urgent human needs. Can it be that the country has largely overcome these obstacles in such a short time? The report quoted above was written just a decade ago; according to conventional wisdom, such problems can't be solved overnight.

Passing through the countryside, a visitor to South Korea today cannot help being aware that something important having to do with trees is under way and that the South Korean Government, known for its tight control over public activities, must be terribly interested in forestry. Sprinkled about the hillsides are billboards bearing forestry slogans such as "Love Trees, Love Your Country." Other signs forbid unauthorized entry into a patch of forest, while still others simply sport a number—"1975" or "1976"—indicating the year in which that hill was planted. That a date, alone on a billboard, carries a recognized message for passersby is testimony in itself of the pervasive awareness of forestry that has, one way or another, been instilled in the populace. And everywhere the trees, the proof that something real has come of all this: row upon row of young trees that in parts of the country seem to cover virtually every spot of land not being farmed. Large areas of South Korea have been transformed from lands of barren hills into lands of young pines; according to government figures, more than one-third of the national land area is stocked with trees less than ten years old. While official statistics here, as anywhere,

"Large areas of South Korea have been transformed from lands of barren hills into lands of young pines."

should be taken with a grain of salt, the country is clearly in the process of changing its face.

To be sure, the historical obstacles to sound forest management have not withered away; South Korea's forestry sector faces plenty of technical, economic, and managerial problems. Planting failures on long-abused lands now bereft of organic matter are not rare, while pests are killing trees in some areas. But a critical about-face has occurred, and the country's challenge is increasingly one of instituting optimal management rather than of halting the spiral of degradation.

While desultory efforts at village forestry had been tried since the fifties, the really dramatic turnabout occurred in 1973, when the government devised a prominent new forestry policy and law. Before then, the national emphasis had been on reducing the industrial timber deficit, relying mainly on the work of the government's forestry department. Village-level forestry groups—which had emerged spontaneously in some areas over the previous several centuries—were encouraged in principle but not given the strong support that would later result in their establishment throughout the country. Since 1973, in contrast, priority has been placed on meeting the needs of the rural population by enlisting their energies and unused lands. That a community-based approach could simultaneously provide more wood for the forest-products industry was also recognized.

The new interest in forestry for rural needs was a logical extension of the much broader shift in national development policy that had occurred two years earlier. While boosting the gross national product incredibly fast, South Korea's rapid industrial growth during the sixties pulled more people to the cities, widened urban-rural income disparities, and caused general social and economic dislocation in the villages. In 1971, a major new program known as the *saemaul*, or "new community," movement was launched. Billed as a self-help program by which villages could advance economically and build local institutions, the *saemaul* campaign has mobilized villagers to construct irrigation works, roads, bridges, water supplies, and electrical facilities. While it may not represent the spontaneous outpouring of community spirit that government leaders like to portray, the *saemaul*

movement has unquestionably helped bring a better material standard of living to the countryside.

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Following in the same spirit, the new forestry campaign has tried to mobilize villagers to plant public and private lands, to form cooperatives to produce and market assorted nonwood products such as mushrooms and valuable leaves, and, above all, to establish firewood lots to meet local needs. The program has been implemented through an unusual combination of private and governmental organizations. Building on Korea's long history of village cooperative societies and the scattering of forest associations already in existence, the government encouraged the establishment of Village Forestry Associations (VFAs) in nearly every village. Nominally a private body, a local association consists of a representative from every household in the village—membership is mandatory—and is directed by an elected chief. The VFAs are all part of a nationwide nongovernmental network, the Korea National Federation of Forest Association Unions, which is headquartered in Seoul.

The real meaning of "nongovernmental" in this case is hard to fathom. The federation's national, provincial, and local officers work parallel to, and in tandem with, equivalent national forest-department officers. The federation and its member village associations receive funds, technical assistance, and policy direction from the government, yet when the World Bank supported an expansion of the village woodlot program, it worked directly with the federation. According to one federation official: "The network of forestry associations has provided the missing link between the government and the villagers. Village forestry would have failed if the government had simply ordered people to carry it out. Through the associations, villagers have developed a better understanding of their forestry problems and a willingness to work to solve them for their mutual benefit." Still, how an organization can at once be a government creation with mandatory membership and a nongovernmental group reflecting a voluntary community spirit remains mysterious to most outsiders.

South Korean villages are precisely boundaried administrative entities. Often they comprise a natural geographic unit, such as a farmed

valley and its surrounding hills. As a first step in carrying out a fire-
wood plantation project, officials from the government, federation, 45
and village association together calculate community wood require-
ments and identify suitable lands—usually hillsides of little agricultur-
al potential—for meeting this need. Most of the chosen lands are pri-
vately owned; the owners are given the option of either reforesting
the areas themselves or turning them over to the VFA in return for
one-tenth of future proceeds from their plots. Though this share of
eventual profits is not great, most landowners, who have received
virtually no income from their plots in the past, give the land to the
VFA.

Through this profit-sharing mechanism the Koreans have managed to co-opt private land for public purposes, overcoming the constraints that private land tenure had previously placed on forest improvement. The landowners have no choice about participating one way or another, but they also receive tangible benefits as a result. Such a combination of latent stick with visible carrot seems to characterize many of South Korea's rural development programs.

The Village Forestry Association, in other words the whole village, plants, tends, and harvests the woodlots without pay. As wood is harvested, it is distributed among households; the proceeds from any marketable surplus are put into a cooperative fund for further community development projects. By the end of 1977, 643,000 hectares of village woodlots—which are primarily for fuel, though many also include trees planted for commercial purposes—had been established in this manner. According to Bong Won Ahn, a federation official who helped plan this enterprise: "The fuelwood component of our forestry program is essentially finished. We calculated the needs and set planting targets, and now these have been met. By the early eighties, when increasing amounts of wood will be harvested from the new plantations, our rural fuel problems will be largely solved."

Critics of the program have argued that popular participation in the village associations, and in the *saemaul* movement generally, is as much a consequence of an authoritarian government's heavy hand as it is a genuine outpouring of civic spirit. After carrying out detailed

public surveys in one rural district, a German sociologist wrote that "the Forest Associations are meant to be voluntary member organizations, but in reality they are top-down government controlled organizations with compulsory membership and membership fees." Peace Corps workers living in villages recently told a visiting journalist that the regimentation of the *saemaul* movement is resented by many villagers. "They don't like having to attend so many lectures and singing *saemaul* songs at six o'clock every morning and being told what to do all the time," said one.[68]

Yet the physical and economic achievements of the village forestry and *saemaul* campaigns are there to see, and the benefits have been well distributed among the peasantry. It seems unlikely that such widespread cooperative behavioral changes could be long sustained by compulsion alone. Korea's Confucian tradition, with its emphasis on obedience to hierarchical authority and on social cohesion, undoubtedly helps explain the success of the programs. But beyond that, the glue binding people together in these efforts may be the genuine personal benefits they receive from their participation. For the many families who had been forced by wood scarcity into buying coal for home heating, for example, the switch to locally grown wood has meant an average 15 percent increase in income. By eliminating middlemen, the cooperatives selling mushrooms and other forest products have greatly boosted the prices received by the peasant producers.[69]

South Korea's forestry program bears certain striking similarities to China's, though the countries are poles apart ideologically. In both cases, the central government has made a strong political commitment to community forestry and has backed that commitment up with technical assistance. In both, an essentially authoritarian national government has created local-level participatory institutions for the implementation of forestry goals. While participation in these local structures is mandatory, it is not meaningless: people are working together for the solution of problems that can only be tackled on a communal basis. Certainly South Korea lacks China's overall commitment to economic equality. Yet, when it comes to community forestry, the benefits in both countries have been largely reaped by

those doing the work rather than been raked off by moneylenders or big landowners.

Given the two countries' cultural and political similarities, is South Korea's experience any more relevant than China's to other developing countries? Perhaps this question is itself misleadingly fashioned. For while neither nation offers a directly duplicable forestry model for other societies, no country will ever offer such a panacea. That is not the same, however, as saying that forestry success stories—even in countries whose broader social and political patterns may lack appeal or relevance—do not offer useful lessons to be applied elsewhere.

Development successes of any sort often appear in retrospect to have been the inevitable consequence of uniquely favorable conditions. Hence, one hears it said, the Chinese could wipe out hunger and reforest their landscape "because they are Chinese." Likewise, foresters elsewhere are beginning to dwell on the peculiarities of South Korean culture and politics that brought about its recent successes. While reflecting obvious truths, this perspective omits something crucial: successes never seem inevitable until they actually materialize. In the late forties, China's potential for ecological restoration had been all but written off by the experts. As recently as the late sixties, South Korea's forestry problems appeared insurmountable to many, who cited plenty of failed tree-planting projects in support of their opinion. Yet, in both cases, specific policy decisions and the creation of appropriate new institutional structures preceded the transformation of hopeless situations into inevitable success stories.

The combination of a strong political commitment at the top with broad public participation and shared benefits at the bottom, which characterizes forestry efforts in both China and South Korea, is a pattern whose possibilities have yet to be explored in many countries. Yet logic, experience, and economic realities suggest that only the rural people themselves will be able to plant, protect, and harvest trees on the scale required in coming decades. Unless institutions are created that give them the means to do so, and that insure they receive the fruits of their own labor, the interlocking crises of wood scarcity and land degradation can only deepen.

Gaining Ground in Gujarat

48 Of the world's most desperately deprived people, the 800 million or so living in what has been termed "absolute poverty," one-third live in India. Likewise, a good share of those suffering the effects of severe firewood and timber scarcity and of land degradation live in India. What happens with Indian forestry, while of interest and relevance to outsiders, is important above all in its own right; for as India's landscape goes, so goes the welfare of hundreds of millions of people.

Within the last decade, the need for radical shifts in forestry practices has been widely recognized in India. The country's technically skilled, highly professional forest service has, it is now apparent, been both a blessing and a curse. Its patient, conservative management of those forest reserves it could protect from encroaching farmers has prevented the sort of rapacious, shortsighted commercial logging that is depleting forests in many Third World countries. But in the face of steadily growing demand, the extremely low wood output from India's reserves has resulted in soaring lumber prices and a critical shortage of pulp. Meanwhile, the scattered trees of the Indian countryside, which supply the daily forest-product needs of most of India's 650 million people, are vanishing. Firewood, fodder, and small timber are becoming ever more scarce and expensive, dung burning is more prevalent, and the environmental problems associated with land denudation are becoming more acute. At the same time, the forest reserves themselves are being depleted by the spillover effects of the spreading rural wood famine.

The urgent need for the reform of Indian forestry was spelled out in national policy documents in 1972 and 1973. Culminating years of study, the reports of the National Commission on Agriculture called for new programs of "production forestry"—the application of modern, intensive timber management in forest reserves to boost commercial timber output—and "social forestry"—the growing of trees outside the reserves to meet the small-scale needs of the people, to enhance the environment, and to provide aesthetic improvements and recreation. As with much government business in India, the national government could lay out policy directions and promise finan-

"The constraints on community forestry in India have been less technological and economic than sociological and bureaucratic."

cial assistance to the states, but it was up to the 21 individual state governments to implement the new strategies.[70]

In the last-half decade, production forestry has, in fact, gotten off to a fairly good start in many parts of the country. While requiring far-reaching changes in timber-management practices, production forestry—unlike social forestry—has not required major reforms in the nature of the forester's role and relations with people. Not surprisingly, the social forestry program is, by comparison, still fumbling at the starting gate on a nationwide basis. Many of India's states have done precious little to carry out the ambitious community forestry plans described in 1973.

Official perception of the importance of the activities now labeled social forestry is by no means new in India. Back in 1952, the young nation devised a National Forest Policy that stressed the need to promote village forestry. To instill a "tree-consciousness" among people, an annual festival of trees called Vanamahotsava was encouraged. Subsequent five-year plans have invariably called for the spread of village woodlots and the planting of trees among farm fields. Yet "unfortunately, even after a lapse of 26 years, the desired objectives have not been achieved," observes S. A. Shah, a leading Indian forester. "The natural resources needed for the practice of social forestry—land and manpower—are available in adequate quantities. What is lacking is the mechanism and the methodology to marry the two."[71]

Social forestry has never received the funding needed to get it off to a strong start, but lack of money has not been the chief obstacle to success. Nor have suitable technologies been absent: if there is one thing Indian foresters know how to do well it is raising trees. At the top, institutions have not been created to encourage foresters to transcend their traditional limited roles as guardians of the reserves; at the bottom, means have not been established to secure the cooperation of the people in solving what all recognize as critical problems. The constraints on community forestry in India have been less technological and economic than sociological and bureaucratic.

Of the states that have given community forestry a serious try, Gujarat stands out as the acknowledged front-runner. In Gujarat, new forestry institutions and attitudes are evolving that spell progress rather than progressive deterioration. The state from which Mahatma Gandhi emerged to lead India to independence is now providing national leadership of another sort.

Gujarat's creative forestry initiatives have been born of necessity; the state is one of the most tree-poor regions in India—indeed, in the world. Less than 10 percent of the state is labeled forest reserve, and only half that area contains commercially exploitable timber. Mostly semiarid, the state includes just .06 hectares of forest reserve for each of its 31 million residents, less than half India's extremely low national average.[72]

Statewide fuelwood consumption in 1975 was 4.8 million tons, but only 200,000 tons were officially extracted from reserves; the remainder was either imported from other states, gleaned from increasingly barren community lands, or poached from reserves. Over the last 15 years, the market price of firewood in Gujarat has climbed faster than the market prices of electricity and oil. Special government depots sell firewood cheaply to the poorest of the poor, those who have access to subsidized food as well. Dung burning is also widespread. So dear are poles and firewood in Gujarat that, according to the forest department, "fruit and fodder trees . . . are cut down in the prime of life from agricultural lands to make easy and quick money." Fodder—the production and use of which is integrally related to forestry problems in India—is also incredibly scarce. When drought grips Gujarat, as it often does, the always sparse grasslands become totally inadequate to sustain the livestock population, and the state government must import millions of kilograms of grass.

Bleak as Gujarat's forestry outlook is, the state does have certain advantages. Although 40 percent of the rural population scratches by below the official "poverty line," which is calculated only to provide bare subsistence, the state's literacy rate of 36 percent is one of India's highest. The state government is reputed to be one of the most efficiently administered in India. Acutely disadvantaged groups, the

so-called tribals and untouchables, make up one-quarter of the total population, and one-fifth of all rural households are headed by landless farm laborers. But the state is renowned for its successful cooperative movements—especially the huge Amul Dairy cooperative, which has improved the lot of poorer farmers in particular, and the Forest Labourers Cooperative Societies, which have organized and bettered the position of what had been some of the world's worst-off workers.[73] In general the state's population displays a widespread civic spirit; pride in Gujarat's role as the birthplace of the Gandhian movement is deeply felt.

Latent advantages are not transformed into concrete results without imaginative people who are able to break with the forms of the past. In Gujarati forestry, this critical leadership was provided in particular by M. K. Dalvi, the former Chief Conservator of Forests whom many now call "the father of social forestry in Gujarat." Dalvi describes the origins of Gujarat's program:

> It had long been obvious that the state's limited forest reserves, no matter how well-managed, could never provide more than a fraction of our wood needs. Back in the early sixties we had the idea of creating new forests outside the reserves, but we tried to do this with the same methods, and the same attitudes, with which we had managed the reserves. We learned some hard lessons. In 1969 we decided to try a new approach. Earlier failures had made clear the need for the forest service to build a new relationship with the people, so we formed a new branch of the department to pursue what we then called "extension forestry." This new group was to educate the population about the importance of forestry through school presentations, public lectures, and so forth, and, most important, it was to get people involved in growing more trees throughout the state.

The first part of what has evolved into a many-dimensioned program was the establishment of plantations alongside roads and canal banks. The state owns these strips of land and has carried out the planting on them, but each stretch of plantation is linked to a nearby

community that has grass-cutting rights among the trees, helps pro-
tect the saplings, and shares in the profits of the operation. Accord-
52 ing to B. K. Jhala, a senior member of the state's extension branch:

> Our early roadside and canal-bank plantations did not involve public participation to the degree that we hope social forestry can achieve, but they nevertheless marked a critical psychological turning point. Seeing stands of trees arise on what had been desolate ground, people started to realize that forestry is possible around their communities, and that trees can grow quickly. The new plantations also gave many people their first positive impressions of the forest department. They saw that our activities could benefit them directly.

By 1978, about 6,000 of the state's 17,000 kilometers of roads and canals were lined with new forests, and each year trees are planted along another 1,500 kilometers.[74]

A second important goal of the forest department is to encourage private groups and individuals in the cities, and farmers in the countryside, to plant trees on available lands. So anxious is the department to make Gujarat green—for aesthetic and environmental as well as economic reasons—that it provides seedlings and advice free of charge to anyone who will take them. Schoolchildren in particular have been mobilized, and the state's cities are becoming more pleasant as trees spring up around schools, government agencies, and stores. But the really big potential for private forestry exists on farms.

So far, commercial forestry has been integrated into farming mainly among richer farmers with larger landholdings. Some farmers have abandoned traditional crops altogether to grow trees, usually fast-growing eucalyptus hybrids, on their lands. One has planted 73 of the 77 hectares of irrigated land under his control with eucalyptus trees. Watered and fertilized, the trees grow incredibly fast: his best specimen reached a height of 82 feet in four-and-one-half years. The trees are harvested at five years and then immediately coppice (send up shoots from the stump) so that several consecutive harvests are possible before replanting is necessary. The trunks of the trees are

sold for construction uses while the branches, bark, and leaves are sold for fuel. Grass fodder and date palms are sometimes planted between the rows. This farmer is making more profit per hectare growing trees than he previously did growing long-staple cotton, and claims to be hiring more labor, with the work spread through the year rather than being concentrated during the frenetic agricultural harvest period.

Farms of this sort have amply demonstrated the biological and commercial potentials of tree farming in Gujarat, but hardly constitute "community" forestry. The forest department is now considering a program of subsidies to help smaller farmers plant trees on the eroding, marginal portions of their farms. Many farmers could raise their incomes and better protect soil quality through forestry, but they are too poor to wait even a few years for the cash returns on such an investment. Special credit and aid measures will be necessary to tide them over the initial years if private tree growing is to spread among poorer farmers.

The core of social forestry in Gujarat is the village plantation scheme. Back in 1973, following the initial success of the roadside and canal-bank program, foresters began visiting villages to discuss the possible establishment of plantations on some of their communal lands. They proposed to the *panchayats*, the elected councils that govern each village, that they set aside a minimum of four hectares for this purpose. The department would supply seedlings and pay poorer villagers to do the preparation and planting; the villages would in turn guarantee to protect the areas from grazing and unauthorized gathering. The villages would have the right to harvest grass and fruit from the plantations free of charge. When it came time to harvest the trees, the *panchayats* and forest department would split the proceeds. Harvested firewood and timber would be sold through government-run depots at prices well below those of the marketplace.

"When we first made these proposals the *panchayats* were suspicious," recalls Dalvi. "We had to visit some villages five or six times over a year or two in order to convince them of the benefits, and to allay their fears about giving up land." By 1978, after four years of

effort, nearly 3,000 of the state's 18,000 villages had established woodlots through this program; each year more agree to enter the scheme, and many have decided to devote more than the minimum four hectares to forestry. Some have even given precious irrigation waters over to tree growing.

One reason for the village program's spreading popularity is the quick returns it generates. It is commonly thought that forestry takes too long to be attractive or feasible to poor villagers, but this notion has been disproved in Gujarat. "Most of the lands we're planting are called grazing lands, but in reality they're nothing more than exercise grounds that have scarcely produced a blade of edible grass in years," observes Jhala. After one year of protection from livestock, grass that can be harvested by hand usually springs up on these same lands. Suddenly the villagers are receiving economic benefits from an area that was formerly worthless. In the second year, some fruit trees begin to produce as well. And, even in the absence of irrigation, most of the tree species planted grow quickly enough to convey an obvious message to nearby residents. "Rhetoric about improving the environment and quality of life does not make any sense to the rural folks," S. A. Shah points out, but it does not take long for these "hard realists" to recognize real benefits materializing before their eyes.[73]

Another potentially significant component of the state's social forestry program is just now getting under way. Large forest areas have been severely degraded by pilferage and by landless drifters who practice shifting cultivation wherever they can get away with it. Efforts to establish plantations in these reserve areas have been consistently frustrated. The state is now planning an innovative measure that may at once create forest resources and provide a secure, reasonable income to those now undermining reforestation efforts. Through what foresters are calling the "social security" program, landless families will be placed in charge of an area—initially 2.5 hectares—and be paid wages year-round to plant seedlings and protect them to maturity. The family will be assigned an additional area for planting each year until the first year's trees are ready for harvest ten or more years later, at which time the family will receive 20 percent of the proceeds from the sale of the timber. Thus currently rootless people will both re-

"By 1978, after four years of effort, nearly 3,000 of the state's 18,000 villages had established woodlots."

ceive a steady income and have a personal stake in the quality of the forests they tend.

As practiced to date, social forestry in Gujarat has led to neither the self-sustaining community involvement nor the transformation of social relations that community forestry can in theory entail. The village woodlot program is clearly an operation of the state forest service rather than a self-help scheme. The use of the *panchayats* as the main filters through which village opinions are expressed and benefits are distributed is enough in itself to keep the program from rocking the socioeconomic boat; the tendency for these bodies to be dominated by economic elites and political factions is legendary. As the local forestry program continues and villagers gain experience in its management, state officials say, more control may be handed over to village institutions. The existing village forestry program is unlikely in itself to upset the stratification of social classes. Still, to the extent that procedures are set up whereby new wealth is created on communal lands and is shared equitably among villagers, the absolute well-being of the poor will be improved. The proposed "social security" program, in particular, will help some landless people accumulate assets and gain more control over their lives.

Even under existing conditions, the degree of cooperation by Gujarat's villagers has been phenomenal. The best evidence of this lies in the absence of good fencing around both the roadside and village woodlots. The trenches, live cacti, or thorny shrubs now used to demarcate the forests would scarcely slow down a person intent on stealing some fodder or fuel. "These barriers are there more for psychological than for physical reasons," says one official, "and the amazing lack of stealing is an indication of the people's support for the social forestry program." The barbed wire often deemed essential by foresters working in less cooperative environments would be prohibitively expensive in India—and in most developing countries, for that matter. Its absence in Gujarat bodes well for the future of community forestry.

Gujarat's social forestry program would be enhanced by a broader approach to the problems it is addressing. The state's firewood supplies are so inadequate, and unused land of decent quality is so rare,

that fuel scarcity will never be eliminated by tree planting alone. Alternative energy sources and wood conservation are also needed, and, ideally, those introducing forestry to a village would simultaneously promote these. As the program is expanded with World Bank assistance, officials plan to integrate household demonstrations of efficient cooking stoves into the village forestry program, but in general wood conservation has not received anything approaching the priority attention the situation demands. However, a more efficient means of cremation, which reduces the wood used in funerals from the usual 400 to 500 kilograms to just 160 kilograms, is already being pushed by foresters and a private social organization in Gujarat. In a country of 650 million where virtually all the dead are cremated, the new crematorium could save a significant amount of wood and also reduce family funeral expenses.

Whatever the flaws of social forestry in Gujarat, they do not negate the central fact: this state has reversed the tide of forest depletion. In forestry, things are improving rather than sliding downhill. Success, of course, breeds more success. Far from being dispirited, as are those fighting land degradation in so many places, Gujarat's foresters seem imbued with a spirit of achievement and hope. If the obvious pride and pleasure with which they describe their evolving programs is any measure, the practice of successful community forestry must be one of the world's more satisfying occupations.

Notes

1. R. Chakravarti, "Forestry for the Masses," mimeographed, Madhya Pradesh State Forest Department, Bhopal, India, 1976.

2. Gunnar Poulsen, in *Man and Tree in Tropical Africa* (Ottawa: International Development Research Centre, 1978), describes the myriad roles of trees in Africa. See also M. M. Pant, "Impact of Forestry on Gross National Product," presented to the Eighth World Forestry Congress, Jakarta, October 16-28, 1978.

3. Food and Agriculture Organization (FAO) Committee on Forestry, "Development and Investment in the Forestry Sector," Rome, March 1978; FAO, *The State of Food and Agriculture, 1977* (Rome: 1978).

4. FAO Committee on Forestry, "Development and Investment."

5. Tropical timber trade reviewed in S. L. Pringle, "Tropical Moist Forests in World Demand, Supply, and Trade," *Unasylva*, Vol. 28, Nos. 112/113, 1976.

6. FAO Committee on Forestry, "FAO's Medium Term Objectives and Proposals for Future Programmes in Forestry," Rome, March 1978.

7. John S. Spears, "Wood as An Energy Source: The Situation in the Developing World," presented to the 103rd Annual Meeting of the American Forestry Association, Hot Springs, Arkansas, October 8, 1978; Club du Sahel, *Energy in the Development Strategy of the Sahel* (Paris: October 1978).

8. *The Global 2000 Report to the President: Entering the Twenty-First Century* (Washington, D.C.: Government Printing Office, forthcoming). The "Forestry Projections" chapter, written by Bruce Ross, provides a useful review of global forest trends and their implications.

9. Persson's basic world inventory is reported in Reidar Persson, *World Forest Resources* (Stockholm: Royal College of Forestry, 1974). Certain of his tables have been updated in Reidar Persson, "The Need for a Continuous Assessment of the Forest Resources of the World," presented to the Eighth World Forestry Congress, Jakarta, October 16-28, 1978.

10. Estimate for 1950 from *Global 2000 Report*.

11. Myths about the Soviet export potential are debunked in W. R. J. Sutton, "The Forest Resources of the USSR: Their Exploitation and Their Potential," *Commonwealth Forestry Review*, Vol. 54, No. 2, 1975.

12. King quote from Norman Myers, "Forests for People," *New Scientist*, December 21/28, 1978. On the controversy over Amazonian logging plans see Larry Rohter, "Amazon Basin's Assets Going Up in Smoke," *Washington Post*, January 5, 1979.

13. Adrian Sommer, "Attempt at an Assessment of the World's Tropical Forests," *Unasylva*, Vol. 28, Nos. 112/113, 1976.

14. Deforestation estimates quoted in World Bank, *Forestry: Sector Policy Paper* (Washington, D.C.: February 1978). The history of global deforestation is reviewed in Erik Eckholm, *Losing Ground: Environmental Stress and World Food Prospects* (New York: W. W. Norton & Co., 1976).

15. On Malaysia, see "Logged Out by 1990," *IUCN Bulletin*, October 1977; "Let's Not Make the Same Mistake," *New Straits Times* (Kuala Lumpur), September 4, 1977; "Tardiness in Timber," *Business Times* (Kuala Lumpur), February 24, 1978. On Thailand, see *UNEP-Asia Report 1977* (Bangkok: UNEP Regional Office for Asia and the Pacific, February 1978); "Drastic Thai Action to Save Teak," *The Times* (London), June 8, 1978; "Only 106M Rai of Forest Land Left," *The Nation* (Bangkok), November 6, 1978; "Forestry," *World Environment Report*, January 1, 1979.

16. Population, Resources, Environment and the Philippine Future, *Philippine Scenarios: 2000 A.D.* (Manila: PREPF, 1978); M. Segura, A. V. Revilla, Jr., and M. L. Bonita, "A Historical Perspective of the Philippine Forest Resources," mimeographed, PREPF, Manila, 1977; A. V. Revilla, Jr., M. L. Bonita, and M. Segura, "An Evaluation of Certain Policies and Programs Affecting Forestry Production Through 2000 A.D.," mimeographed, PREPF, Manila, 1977.

17. Reidar Persson, *Forest Resources of Africa* (Stockholm: Royal College of Forestry, 1977).

18. FAO Committee on Forestry, "FAO's Medium Term Objectives"; Reidar Persson, "Trends in Forest Area," mimeographed, Stockholm, 1977; FAO, *Development and Forest Resources in the Asia and Far East Region* (Rome: 1976).

19. Edouard Saouma, "Statement by the Director-General of FAO," presented to the Eighth World Forestry Congress, Jakarta, October 16-28, 1978.

20. FAO, *Wood: World Trends and Prospects* (Rome: 1967).

21. R. Goodland, "A Plea for Amazonian Diversity," *Anthropology Resource Center Newsletter* (Cambridge, Mass.), December 1978; Lawrence S. Hamilton, *Tropical Rainforest Use and Preservation* (New York: Sierra Club Office of International Environmental Affairs, March 1976); Tosi statement from "Sacred Cow Causing Ecological Disaster in C. R., Local Experts Say," *Tico Times* (San Jose), November 3, 1978; James J. Parsons, "Forest to Pasture: Development or Destruction?," *Revisita de Biologia Tropical*, Vol. 24, 1976, p. 121. Estimate of annual forest shrinkage in Brazilian Amazon Basin from M. K. Muthoo *et al.*, *Situação Florestal Brasileira* (Brasilia: Ministry of Agriculture, 1977).

22. J. P. Lanly, "Régression de la Forêt Dense en Côte d'Ivoire," *Bois et Forêts des Tropiques*, September/October 1969.

23. Hamilton, *Tropical Rainforest Use and Preservation;* "Panama Watershed Management Project Paper," U.S. Agency for International Development, Panama, November 30, 1978.

24. Energy Research and Development Group, *Nepal: The Energy Sector* (Kathmandu: Institute of Science, Tribhuvan University, November 23, 1976).

25. Eckholm, *Losing Ground.*

26. The best current review of firewood problems is J. E. M. Arnold, "Wood Energy and Rural Communities," presented to the Eighth World Forestry Congress, Jakarta, October 16-28, 1978. A shorter version of the paper is J. E. M. Arnold and J. Jongma, "Fuelwood and Charcoal in Developing Countries," *Unasylva*, Vol. 29, No. 118, 1978. See also Eckholm, *Losing Ground.*

27. M. S. Tomar and S. C. Joshi, "Vanishing Forests Vis-a-vis Energy Crisis in Madhya Pradesh by 2000 A.D.," State Forest Resources Survey Organization, Bhopal, India, February 1977.

28. Club du Sahel, *Energy in the Development Strategy of the Sahel;* "Le Deboisement en Haute-Volta," *Le Développement Voltaique* (Ouagadougou), August 31, 1976. Information on Sudan from author's interviews with Sudanese foresters.

29. Comments on Madhya Pradesh based on author's observations and interviews during visit to the state in November 1978. On Bara, Sudan, see Turi Hammer Digernes, *Wood for Fuel: Energy Crisis Implying Desertification—The Case of Bara, The Sudan*, Ph.D. thesis, University of Bergen, Norway, November 1977.

30. See, for example, K. J. Lampe, *Forst in Paktia, Afghanistan* (Frankfurt: Federal Agency for Development Assistance, 1972).

31. On the U.S. Northwest, see Dan Morgan, "U.S. Under Pressure to Cut More Trees," *Washington Post*, April 2, 1978; and John H. Beuter, K. Norman Johnson, and H. Lynn Scheurman, *Timber for Oregon's Tomorrow: An Analysis of Reasonably Possible Occurrences* (Corvallis: Oregon State University School of Forestry, January 1976). On Canada, see F. L. C. Reed and Associates, *Forest Management in Canada*, Vol. 1 (Ottawa: Canadian Forestry Service, January 1978). On the Soviet Union, see Sutton, "The Forest Resources of the USSR."

32. S. K. Chauhan, "Tree Huggers Save Forests," *Development Forum*, September 1978.

33. Cited in Norman E. Johnson and Gary F. Dykstra, "Maintaining Forest Production in East Kalimantan, Indonesia," presented to the Eighth World Forestry Congress, Jakarta, October 16-28, 1978.

34. Johnson and Dykstra, "Maintaining Forest Production."

35. S. D. Richardson, "Foresters and the Faustian Bargain," in *Papers for Conference on Improved Utilization of Tropical Forests*, Madison, Wisconsin, May 21-26, 1978 (Washington, D.C.: U.S. Forest Service Forest Products Laboratory, 1978).

36. Jack Ewell and Louis Conde, "Environmental Implications of Any-Species Utilization in the Moist Tropics," in *Papers for Conference on Improved Utilization of Tropical Forests;* "The World's Forests," FAO Fact Sheet, Rome, March 1978.

37. Agro-forestry needs and possibilities are discussed in J. G. Bene, H. W. Beall, and A. Coté, *Trees, Food and People: Land Management in the Tropics* (Ottawa: International Development Research Centre, 1977).

38. Calculated from FAO, *Yearbook of Forest Products, 1976* (Rome: 1977).

39. Saouma, "Statement by the Director-General."

40. World Bank, *Pakistan: Forestry Sector Survey* (Washington, D.C.: June 1978).

41. Lester R. Brown, *The Global Economic Prospect: New Sources of Economic Stress* (Washington, D.C.: Worldwatch Institute, May 1978).

42. World Bank, *Pakistan: Forestry Sector Survey.*

43. Arnold J. Barnett and Chandler Morse, *Scarcity and Growth: The Economies of National Resource Availability* (Baltimore: Johns Hopkins University Press, 1962). 61

44. Council on Wage and Price Stability, *Lumber Prices and the Lumber Products Industry,* Washington, D.C., October 1977; Dwight Hair, "Does the U.S. Have a Shortfall of Timber?," *Journal of Forestry,* May 1978.

45. FAO, *Development and Forest Resources in the Asia and Far East Region;* Gujarat Forest Department, *Social Forestry Project, Gujarat State, for World Bank Assistance* (Baroda, India: August 1978).

46. Arnold, "Wood Energy and Rural Communities"; S. A. Shah, "People's Participation in Forestry for Community Development in India," presented to the Eighth World Forestry Congress, Jakarta, October 16-28, 1978.

47. Arnold, "Wood Energy and Rural Communities."

48. *Ibid.*

49. Nepal calculation reported in John S. Spears, "The Changing Emphasis in World Bank Forestry Lending," presented to the Eighth World Forestry Congress, Jakarta, October 16-28, 1978; global plantation needs reported in Spears, "Wood as an Energy Source."

50. The need and potentials for investment in small-scale paper mills is discussed in "Report on the UNDP/FAO Pulp and Paper Industries Development Programme by the Coordinator," in FAO, *World Pulp and Paper Demand, Supply and Trade-1* (Rome: 1977).

51. Swedish University of Agriculture, Forestry, and Veterinary Medicine, *Forestry in India: A Sector Study* (Stockholm: June 1976).

52. Robert Prinsky, "World's Shortages of Paper Bring Woe to Publishers But Delight to Producers," *Wall Street Journal,* May 28, 1974; Brown, *Global Economic Prospect.*

53. Samuel H. Kunkle, "Forestry Support for Agriculture through Watershed Management, Windbreaks and Other Conservation Actions," presented to the Eighth World Forestry Congress, Jakarta, October 16-28, 1978.

54. "Deforestation in Himalayan Region Cause of India's Worst Flood," *World Environment Report*, November 6, 1978.

55. Kunkle, "Forestry Support for Agriculture." See also Eckholm, *Losing Ground*.

56. U.N. Conference on Desertification, "Economic and Financial Aspects of the Plan of Action to Combat Desertification," Nairobi, August 29-September 9, 1977; Kunkle, "Forestry Support for Agriculture."

57. Norman Myers, *The Sinking Ark* (New York: Pergamon Press, forthcoming); Erik Eckholm, *Disappearing Species: The Social Challenge* (Washington, D.C.: Worldwatch Institute, July 1978).

58. G. M. Woodwell *et al.*, "The Biota and the World Carbon Budget," *Science*, January 13, 1978; National Academy of Sciences, *Energy and Climate* (Washington, D.C.: 1977).

59. Jack C. Westoby, "Forest Industries for Socio-Economic Development," presented to the Eighth World Forestry Congress, Jakarta, October 16-28, 1978.

60. Spears, "Changing Emphasis in World Bank Forestry Lending."

61. M. K. Muthoo, "Socio-Economic Impact of Brazil's Man-Made Forestry Programme," mimeographed, Brasilia, undated.

62. Saouma, "Statement by the Director-General"; Lankester quote from oral statement during conference.

63. FAO Forestry Department, *Forestry for Local Community Development* (Rome: 1978); FAO Forestry Department, *Forestry for Rural Communities* (Rome: 1978); World Bank, *Forestry: Sector Policy Paper*; S. Jacob Scherr, "Amendments to the Foreign Assistance Act concerning Environmental Natural Resources," memorandum, Natural Resources Defense Council, Washington, D.C., September 25, 1978; *Proceedings of the U.S. Strategy Conference on Tropical Deforestation* (Washington, D.C.: U.S. State Department/Agency for International Development, October 1978).

64. Brief examples of China's community forestry efforts are provided in FAO Forestry Department, *Forestry for Local Community Development.* See also Jack C. Westoby, "Making Trees Serve People," *Commonwealth Forestry Review,* Vol. 54, Nos. 3/4, 1975. Estimates of new forest area from Persson, "Need for a Continuous Assessment"; and "Summary Report," FAO/Nepal Study Tour on Multiple Use Mountain Forestry to the People's Republic of China, November 26-December 11, 1978, mimeographed, Rome, undated.

65. William Vogt, *Road to Survival* (New York: William Sloane, 1948).

66. Descriptions of the program available in English include Bong Won Ahn, "Village Forestry in Korea," presented to Eighth World Forestry Congress, Jakarta, October 16-28, 1978; Hans Gregersen, "Appraisal of Village Fuelwood Plantations in Korea," draft, UM/FAO/SIDA Project Case Study No. 2, University of Minnesota, St. Paul, Minn., June 25, 1977; World Bank, *Korea: Appraisal of Rural Infrastructure Project* (Washington, D.C.: February 15, 1976); and FAO Forestry Department, *Forestry for Local Community Development.* Uncited quotations and descriptions in this section are based on the author's interviews and observations during a visit to South Korea in October 1978.

67. FAO/UNDP, *Agricultural Survey and Demonstration in Selected Watersheds, Republic of Korea* (Rome: 1969).

68. Aksel de Lasson, *Report on the Establishment of Forest Management Cooperatives in the Korean-German Forest Management Project* (Eschborn: German Agency for Technical Cooperation, 1978). Robert Shaplen, in "Letter from South Korea," *New Yorker,* November 13, 1978, provides an excellent overview of the political, economic, and military contexts within which the rural development programs have been pursued.

69. Gregersen, "Village Fuelwood Plantations in Korea"; Ahn, "Village Forestry in Korea."

70. *Interim Report of the National Commission on Agriculture on Production Forestry—Man-Made Forests* (New Delhi: Ministry of Agriculture, August 1972); *Interim Report of the National Commission on Agriculture on Social Forestry* (New Delhi: Ministry of Agriculture, August 1973).

71. Shah, "People's Participation in Forestry."

72. Most of the data in this and following paragraphs are from the Gujarat Forest Department's 1978 proposal document, *Social Forestry Project, Gujarat State, for World Bank Assistance;* uncited personal quotations from author's interviews during a visit to Gujarat in November 1978.

73. An interesting account of the social and caste dynamics of the dairy cooperative, which may be relevant to social forestry activities as well, is in A. H. and Geeta Somjee, "Cooperative Dairying and the Profiles of Social Change in India," *Economic Development and Cultural Change,* April 1978.

74. B. K. Jhala, "Social Forestry in Gujarat," mimeographed, Ahmedabad, India, 1978.

75. Shah, "People's Participation in Forestry."

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